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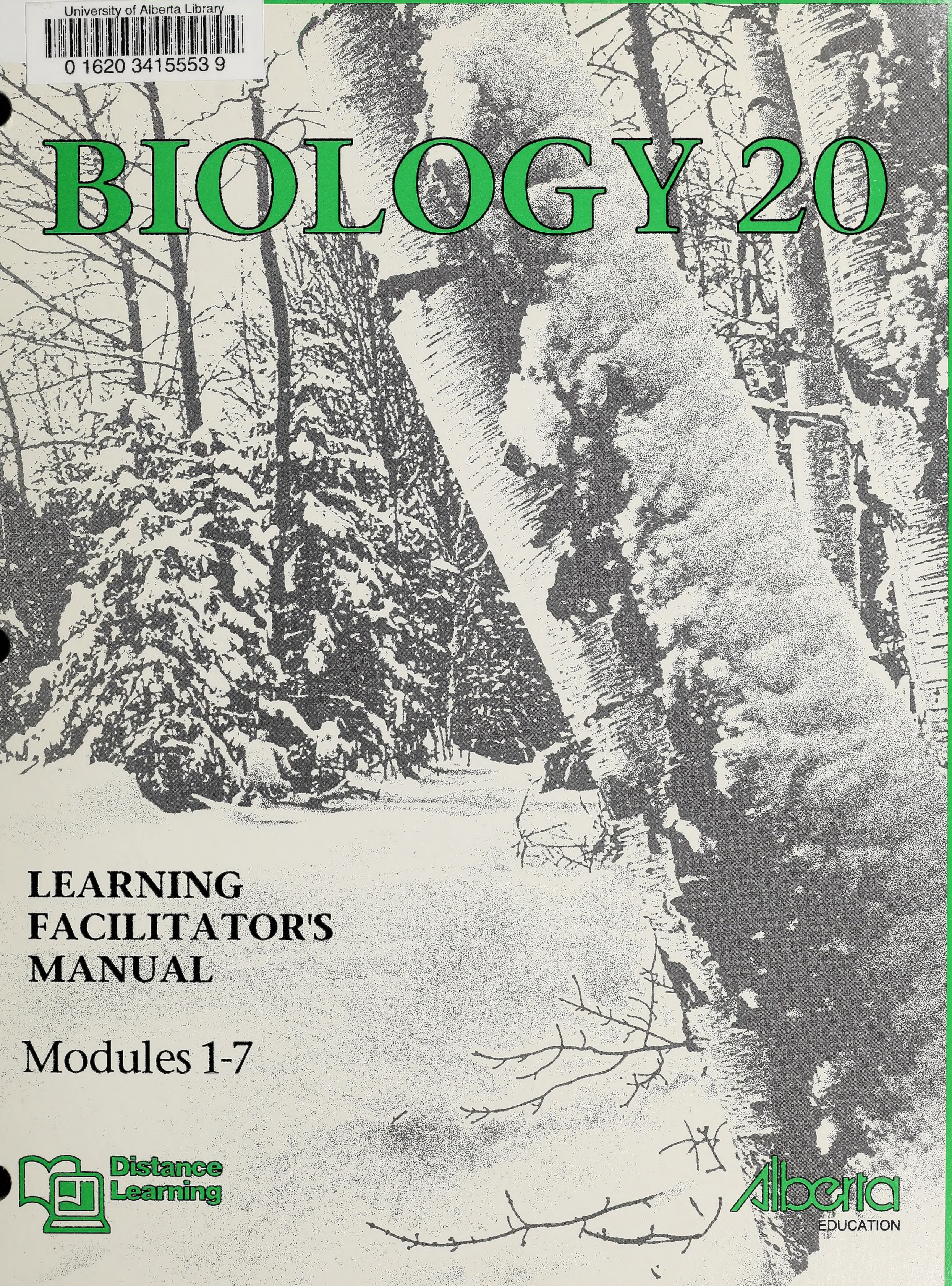

BIOLOGY 20

LEARNING FACILITATOR'S MANUAL

Modules 1-7

Distance Learning

Alberta
EDUCATION

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Biology 20

LEARNING FACILITATOR'S MANUAL

Distance
Learning

Alberta
EDUCATION

Note

This Biology 20 Learning Facilitator's Manual contains answers to teacher-assessed assignments and the final test; therefore, it should be kept secure by the teacher. Students should not have access to these assignments or the final test until they are assigned in a supervised situation. The answers should be stored securely by the teacher at all times.

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This document is intended for	
Students	
Teachers (Biology 20)	✓
Administrators	
Parents	
General Public	
Other	

Biology 20
Learning Facilitator's Manual
Modules 1-7
Alberta Distance Learning Centre
ISBN No. 0-7741-0859-2

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Teachers

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The Alberta Distance Learning Centre is dedicated to upgrading and continually improving your Learning Facilitator's Manual so that it accurately reflects any necessary revisions we have had to make in the student assignments or the sample final test. The types of revisions that will be made are those that make the course more accurate, current, or more effective.

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We look forward to hearing from you!

Contents

Introduction 1

Overview of the Program of Studies 3

Overview of Biology 20 5

Structure of the Learning Package 7

Using This Learning Package in the Classroom 11

Evaluation 15

Introducing Students to the System 18

Module 1 20

Module 2 27

Module 3 34

Module 4 39

Module 5 41

Module 6 48

Module 7 52

Answer Key to the Final Test 60

Student's Copy of the Final Test

Teacher Questionnaire

Introduction

A survey of these course materials will confirm that this new learning package has been specially designed for many kinds of teachers working in a variety of situations.

Which Category Do You Fit?

- ☐ Small Schools Teacher
  - ☐ inexperienced
  - ☐ experienced, but in other subject areas
  - ☐ experienced in teaching high school science, but wanting to try a different approach

- ☐ Distance Learning Teacher
  - ☐ travelling to schools within the jurisdiction
  - ☐ using facsimile and teleconferences to teach students within the area

- ☐ Larger Schools Teacher
  - ☐ inexperienced
  - ☐ experienced in teaching high school science, but wanting to try a different approach

Because these materials have been created by experienced classroom teachers and distance learning specialists, they have many advantages for students and teachers regardless of their situations.

Advantages for Students

- incorporates a strong learner-centred philosophy
- promotes such qualities in the learner as autonomy, independence, and flexibility
- is developed through media which suit the needs and circumstances of the learner
- reflects the experiential background of Alberta students
- opens up opportunities by overcoming barriers that result from geographical location
- promotes individualized learning, allowing learners to work at their own pace

Advantages for Teachers

- allows teachers maximum teaching time and minimizes preparation time
- includes different routes through the materials to suit different learners
- incorporates a wide range of teaching strategies, in particular those using independent and individual learning
- delivers curriculum designed by education specialists that reflects the Alberta Education Program of Studies with an emphasis on Canadian content
- provides learning materials which are upwardly compatible with advanced educational technology

Does it sound like something you could use?

This Learning Facilitator's Manual begins with an overview of the current Alberta Education Program of Studies for Biology 20. This summary is included for inexperienced teachers or those teachers who have found themselves teaching Biology 20 when their training is in other subject areas. This brief summary is not meant to replace the Alberta Education Program of Studies, but rather to help teachers confirm the highlights of the program.

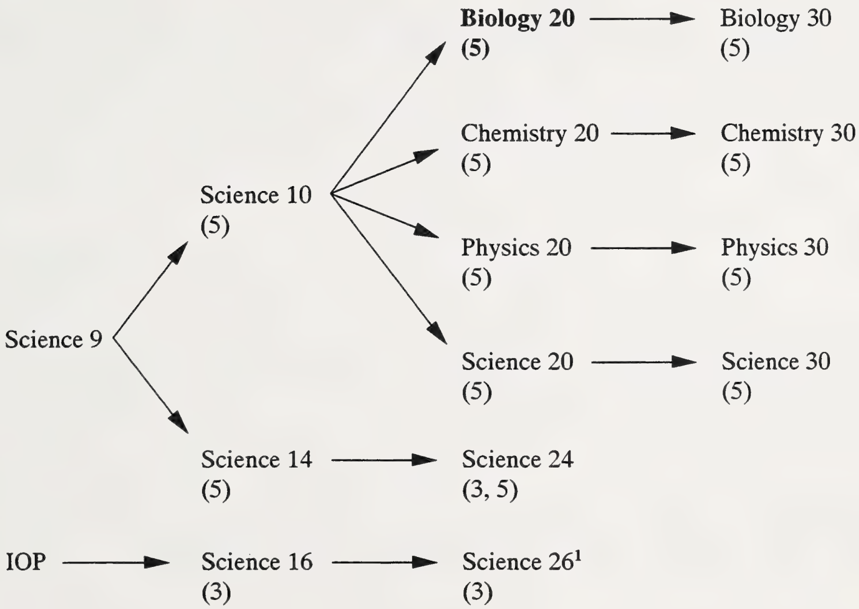
Other parts of this introduction have also been included to help teachers become familiar with this new learning package and determine how they might want to use it in their classroom.

Beyond the introduction the guide itself contains answers, models, explanations, and other tips generated by the teachers who authored this course.

The module booklets and LFMs are the products of experienced classroom teachers and distance learning specialists. It is the hope of these teachers that their experience can be shared with those who want to take advantage of it.

Overview of the Program of Studies

The following diagram illustrates the various course sequences in the Senior High Science Program. Credit values are provided in brackets beneath each of the courses shown on the diagram. Notice that Science 10 is the keystone for the entire Senior High Science Program. Science 10 provides students with the foundation necessary to proceed onto Biology 20.



The Biology 20-30 program emphasizes the key science themes: *energy, matter, change, diversity, systems*, and *equilibrium* as they relate to the biological sciences. These themes provide a means of showing the connections between the units of study in both courses of the program, as well as allowing students to see the nature of the connections to other courses in science. The concepts in biology provide a framework for teachers to show students how individual sections of the program relate to the science themes.

In addition to developing a solid understanding of the fundamental concepts of science and the principles of the biological sciences, Biology 20-30 has the goal of educating students about the nature of science, of technology, and of the interaction between biological sciences and technology. Students must be aware of the tremendous impact of science and technology on society, but at the same time they must be aware of the roles and limitations of biology, science in general, and of technology, in problem solving in a societal context.

The teaching of science using the STS (Science-Technology-Society) approach must centre on the development of scientifically literate and responsible citizens capable of using scientific knowledge wisely for the good of all members of society. The STS approach to science challenges students by developing scientific literacy through experimentation and investigation. This approach motivates students to learn more about science and to apply what they learn to other situations.

Science and technology affect every aspect of the daily life of Canadians. Both science and technology are involved in areas as diverse as communications, travel, agriculture and waste management. But what is science and what is technology? Are they the same or are they different? How do science and technology affect society? How does society control science and technology? If students are to become enlightened, contributing citizens in a constantly changing society they will need to know the answers to these questions.

Scientific literacy is an important goal of secondary school education, as it provides a means for asking and answering some very important questions.

A scientifically literate person has the following characteristics:

- demonstrates a working knowledge and practical understanding of the sciences
- has the ability to evaluate scientific evidence
- understands the processes by which scientific knowledge is developed and can adapt those processes for personal use
- applies science concepts, theories and processes to the investigation of everyday problems
- understands the relationship between science and technology
- demonstrates awareness of how science and technology can function responsibly in a social context
- recognizes the limitations as well as the usefulness of science and technology in advancing human welfare
- demonstrates a continuing interest in science and technology.[1]

The Biology 20-30 *Program of Studies* will be an important document for you as a teacher of Biology 20. Once you understand the rationale behind the course and the expectations of students, you'll know how the different components work together, and you'll be able to make better decisions when planning. Starting with the program of studies is a good investment in time. So, before proceeding any further, you should get the most recent version of this document, as well as the Module 1 Student Module Booklet.

To help make the best use of your time, you'll be asked to read certain pages from the *Program of Studies* and then key ideas will be highlighted with supporting examples from the Student Module Booklet. To begin, please read Program Rationale and Philosophy in the *Program of Studies*.

Did you notice the emphasis on students learning the big interconnecting ideas in a relevant context? This philosophy translates into strategies such as providing an equations sheet for students during exams since the focus is not on memorizing equations, but on applying main ideas. Another example can be found on the Overview of the Module 1 Student Module Booklet. Please read this page and note the focus on main ideas being put into a relevant context.

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[1] Senior High Science Teacher Resource Manual, Curriculum Branch, 1992. Reprinted by permission of Alberta Education.

Please read General Learner Expectations in the *Program of Studies*, paying particularly close attention to the section on skills. It could be argued that the skills may be of greater value to the life-long learning of the student than to the specific course content. Clearly, these skills are intended to be a central part of the course. The Student Module Booklet has attempted to make these skills explicit to the students as they progress through the course. Carefully read through the Science Skills at the beginning of Module 1 and *A Framework for Scientific Problem-Solving Skills* in the Appendix of the Module 1 Student Module Booklet.

How should Biology 20 be taught? Although there are a variety of answers to this question, the learning cycle is an approach that many successful science teachers have been using for years. Please read Specific Learner Expectations in the *Program of Studies* to learn more about the learning cycle. Examples of how the learning cycle can be applied to student learning can be found in each section of the Student Module Booklet. Please quickly survey these pages to find evidence of the learning cycle being used.

Overview of Biology 20

The major science concepts developed in this course are systems, equilibrium, energy, and matter. Diversity and change are subordinate themes that are also addressed. The major concepts allow connections to be drawn between the four units of the course and between all eight units in the two courses in the program.

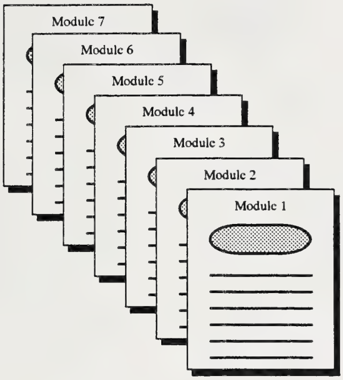
BIOLOGY 20 PROGRAM OF STUDIES		ADLC BIOLOGY 20		RECOMMENDED PERCENTAGE OF AVAILABLE INSTRUCTIONAL TIME
Unit	**Title**	**Module**	**Title**	
1	The Biosphere	1	The Biosphere	10
		2	Biomes and Ecosystems	10
3	Matter and Energy Exchange in Ecosystems	3	Matter and Energy in Ecosystems	20
		4	Populations in Ecosystems	20
2	Cellular Matter and Energy Flows	5	Matter and Energy in Cells	15
4	Matter and Energy Exchange by the Human Organism	6	Matter and Energy in Humans	12
		7	Human Homeostasis	13

Unit 1 focusses on the dynamic equilibria that exist for matter and energy in the biosphere and the systems that regulate those equilibria. In Unit 2, energy from the environment is traced through photosynthetic and cellular respiratory systems with the associated cycling of matter in the form of carbon. Unit 3 examines the characteristics of some of the ecosystems that make up the biosphere, and it examines the interactions of the organisms mediating the flow of matter and energy through those ecosystems. The unit closes with a discussion of how organisms evolve to fill available niches in ecosystems. The particular case of the human organism system and its matter and energy exchanges with the environment is examined in Unit 4, along with its biotic interactions with pathogenic organisms.

You may have noticed that the sequence of the modules (1 to 7) is different than the sequence of Units in the Program of Studies (1 to 4). If the Units are correlated to the modules, the Unit sequence becomes 1-3-2-4. By following the sequence of modules, the course can be presented in a more natural order that supports the main theme of matter and energy in the biosphere. Also, connections between concepts and particularily between modules will be strong. Matter and energy in living systems is introduced in the biosphere; then it is carried through biomes and ecosystems to the level of populations. A discussion of natural selection and evolution closes Module 4. Check the conclusion at the end of Section 2. Module 5, Matter and Energy in Cells, is a bridge module connecting matter and energy in large living systems to matter and energy in cellular systems. While the topics of photosynthesis and respiration are presented at the cellular level, the general principles of these processes are applicable on a global scale as major processes in the biosphere. Completing the Program of Studies requires that matter and energy be studied within the human organism. So now, having explored matter and energy on a global level and a cellular level, the students are ready to study how humans exchange matter and energy with their environment.

Structure of the Learning Package

Module Booklets



The print components involve many booklets called modules. These modules contain guided activities that instruct students in a relevant, realistic setting, as well as assignments that can be used for formative and summative assessments.

The modules have been specially designed to promote such qualities in the learner as autonomy, independence, and flexibility. Writers have incorporated such teaching strategies as working from the concrete to the abstract, linking the old to the new, getting students actively involved, and using advance, intermediate, and post organizers. Many other techniques enable learners to learn on their own for at least some of the time.

The structure of the module booklets follows a systematic design. Each module begins with a detailed table of contents which shows the students all the main steps. It acts as an organizer for students. The overview introduces the module topic or theme. A graphic representation has been included to help visual learners and poor readers. The introduction also states the weightings of each assignment and provides instruction for setting up the response pages that are submitted to the teacher.

The body of the module is made up of two or more closely related sections. Each section contains student activities that develop skills and knowledge centred around a theme.

The activities may involve print, audio, video, computer, or laser videodisc formats. At times the student and the learning facilitator are allowed to choose the activity that best suits the student's needs and interests. Other activities such as the Extra Help and Enrichment are optional pathways. This flexibility caters to each student's personal situation.

The summary focuses on the skills and strategies that the student has learned.

The students should complete each section assignment after they have thoroughly reviewed the section. Some modules also have a final module assignment after the Module Summary.

Contents

Overview
Evaluation

Section 1
Activity 1
Activity 2
etc.
Assignment

Section 2
Activity 1
Activity 2
etc.
Assignment

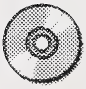
Section 3
Activity 1
Activity 2
etc.
Assignment

Section 4
Activity 1
Activity 2
etc.
Assignment

Module Summary

Media

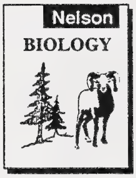
VIDEOCASSETTE


LASER VIDEODISC

The package also includes references to media. Some types of media such as computer disks and laser videodiscs are optional choices for students; however, there are activities that require students to view certain videos. These mandatory videos are listed on the following page. It is important that you acquire these videos as you are planning the course. In addition to the mandatory videos, optional videos have been mentioned at various points in the modules. A list of the optional videos is also included on the following page. More information about the videos can be found within the LFM.

Textbooks and Reference Books

The package requires students to use *Nelson Biology*, published by Nelson Canada, as their textbook. Additional reference materials for teachers are indicated later in this manual.



Lab and Other Materials

The package includes references to lab materials. A list of necessary materials is included later in this manual. A lab kit suitable for individual students is available for purchase from the LRDC.

Materials, Media, and Equipment

Mandatory Components

Equipment (Hardware)	Media	Materials
• VCR	• Mandatory Video List: *Global Warming, Hot Times Ahead* (ACCESS Network) *Aspects of Ecology: Ecosystems* (ACCESS Network) *Aspects of Ecology: Circles and Cycles* (ACCESS Network) *If You Build It* (ACCESS Network) *The Athabasca: A Case Study* (ACCESS Network) *Aspects of Ecology: Populations* (ACCESS Network) *Organic Evolution: In the Beginning* (ACCESS Network) *Organic Evolution: Darwin, Naturally* (ACCESS Network) *Human Body: Digestive System* (ACCESS Network) *Human Body: Respiratory and Circulatory System* (ACCESS Network) *Healthy Choices, Healthy Hearts* (Alberta Heart and Stroke Foundation) *The Immune System: Your Magic Doctor* (ACCESS Network)	• LFM for Biology 20 • one complete set of module booklets (7) • There is a final test.

Videocassettes or laser videodiscs used in the course may be available from the Learning Resources Distributing Centre or ACCESS Network. You may also wish to call your regional library service for more information.

Optional Components

Equipment (Hardware)	Media	Materials
	- videocassettes - laser videodiscs - Optional Video List: *Energy and the Food Web* (ACCESS Network 8446) *Water in Alberta: The Living Flow* (ACCESS Network 2727) *Water: A Fascinating Liquid* (ACCESS Network 3434) *Recycling: The Endless Circle* (National Geographic) *Creatures of the Pond* (Kinetic Films) *Planet Under Pressure: Ozone* (TV Ontario) *This Living World, Volume 2: The Forest* (King Motion Pictures) *Natural Selection, Part 1: Natural Selection and Microevolution* (Human Relation Media) *Organic Evolution: Factoring in Mendel* (ACCESS Network) *Natural Selection, Gradualism Versus the Punctuated Equilibrium Theory of Evolution* (ACCESS Network) *One Voice in the Cosmic Fuge* (COSMOS) *Photosynthesis* (ACCESS Network) *Experiments in Photosynthesis* (Marlin Motion Pictures) *Cellular Respiration: The Cell and Energy* (ACCESS Network 3242) *Respiratory and Circulatory System* (ACCESS Network 324906) *Homeostasis: Osmoregulation* (ACCESS Network 3244) *Have You Considered Organ Donation?* (Kidney Foundation of Canada)	

Using This Learning Package in the Classroom

Conventional Classroom

Whether your classroom has desks in rows or tables in small groups, you may be most comfortable with a learning system that you can use with all your students in a paced style. In other words, you may want a package that will suit all of your students, so they can move through the materials as one group or several small groups. Because these materials contain different routes or pathways within each module, they can address various learning styles and preferences. The materials also include many choices within the activities to cater to different thinking levels and ability levels. Because of their versatility and flexibility, these materials can easily suit a conventional classroom.

Open-Learning Classroom

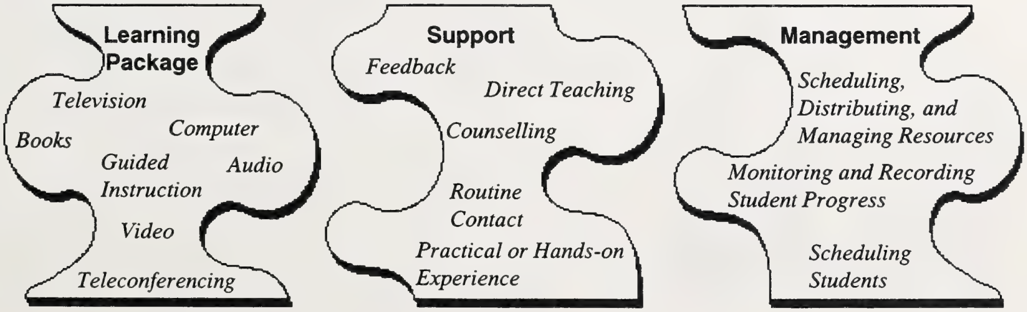
Open learning is the concept of opening up opportunities by overcoming barriers of time, pace, and place by giving the learners a package specially designed to enable them to learn on their own for at least some of the time.

Such a concept is not new. Many teachers can recite attempts to establish an individualized learning system as they recognized the importance of trying to personalize courseware to meet each individual student's needs. But these efforts often failed due to lack of time and lack of quality materials that conformed to Alberta specifications.

Due to advanced educational technology and improved Alberta-specific learning packages, a student-centred approach is now possible. Improved technology now allows us to provide support to learners individually, regardless of their pace or location. A teacher cannot be in twenty-eight places at one time offering guidance. However, media and a well-designed learning package can satisfy individual needs. Technology can also help provide an effective management system needed to track the students as they progress independently through the materials.

The key to a successful open-learning system depends on three vital elements: a learning package specially designed to enable students to learn effectively on their own for at least some of the time; various kinds of learner support; and a management system and style that ensures that the open-learning system runs smoothly.

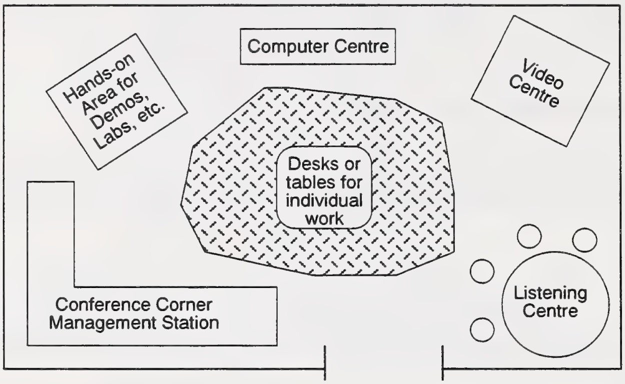
The Key to a Successful Open-Learning System



Learning Package

The specially designed learning package needed for a successful open-learning system has been developed for you. The objectives teach current Alberta specifications using strategies designed for individualized instruction. As the learning facilitator, you need to be sure to have all the components in the learning package available to students as needed.

If adequate numbers of media are available to satisfy the demand, a centre can be established for specific media.


Computer Centre
Hands-on Area for Demos, Labs, etc.
Video Centre
Desks or tables for individual work
Conference Corner Management Station
Listening Centre

You may not have the luxury to have enough hardware to set up a permanent video or computer centre in your classroom. In that case, students should be encouraged to plan ahead. Perhaps every three to five days they should preview their materials and project when they would need a certain piece of media. This would allow you to group students, if necessary, or reserve media as required.

Support

Support is definitely a key element for successful learning, and when you're planning an individualized, non-paced program, you need to carefully plan when and how support will be given.

The materials contain a form of consistent support by providing immediate feedback for activities included in the module booklet. High school students have solutions, models, explanations, and guides included in the appendix of every module booklet. These are included so students can receive immediate feedback to clarify and reinforce their basic understanding before they move on to higher levels of thinking.

As the learning facilitator, you may be needed to offer more personal guidance to those students having difficulty, or you may need to reinforce the need for students to do these activities carefully before attempting the section assignments.

The activities include choices and pathways. If a student is having difficulty, you may need to encourage that student to work on all the choices rather than one. This would provide additional instruction and practice in a variety of ways.

Another form of support is routine contact with each individual. This might be achieved with a biweekly conference scheduled by you, or as students reach a certain point (e.g., after each section is completed), they may be directed to come to the conference area.

Special counselling may be needed to help students through difficult stages. Praise and encouragement are important motivators, particularly for those students who are not used to working independently.

Direct teaching may be needed and scheduled at certain points in the program. This might involve small groups or a large group. It might be used to take advantage of something timely (e.g., election, eclipse, etc.), something prescheduled like the demonstration of a process, or something involving students in a hands-on, practical experience.

Support at a distance might include tutoring by phone, teleconferencing, faxing, or planned visits. These contacts are the lifeline between learners and distance education teachers, so a warm dialogue is essential.

Management

Good management of an open-learning system is essential to the success of the program. The following areas need action to ensure that the system runs smoothly:

- Scheduling, Distributing, and Managing Resources – As discussed earlier, this may require a need for centres or a system for students to project and reserve the necessary resources.

- Scheduling Students – Students and teachers should work together to establish goals, course completion timelines, and daily timelines. Although students may push to continue for long periods of time (e.g., all morning), teachers should discourage this. Concentration, retention, and motivation are improved by taking scheduled breaks.

- Monitoring Student Progress – You will need to record when modules are completed by each student. Your data might also include the projected date of completion if you are using a student contract approach.

Sample of a Student Progress Chart

Biology 20		Module 1	Module 2	Module 3	Module 4	Module 5	Module 6	Module 7	Final Test
Billy Adams	P								
	A								
Louise Despins	P								
	A								
Violet Klaissian	P								
	A								
P = Projected Completion Date A = Actual Completion Date									

The student could keep a personal log as well. Such tracking of data could be stored easily on a computer.

- Recording Student Assessments – You will need to record the marks awarded to each student for work completed in each section assignment. The marks from these assignments will contribute to a portion of the student's final mark. Other criteria may also be added (a special project, effort, attitude, etc.). Whatever the criteria, they should be made clear to all students at the beginning.

Sample of a Student Assessment Chart

Biology 20	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6	Module 7	Year's Average	Final Test	Final Mark
Billy Adams	**67**	**65**	**54**	**47**	**78**	**67**	**68**	**73**		
Louise Despins	**43**	**50**	**54**	**55**	**48**	**42**	**57**	**50**		
Violet Klaissian	**65**	**65**	**66**	**68**	**67**	**70**	**69**	**77**		

Letter grading could easily be substituted.

- Recording Effectiveness of System – Keep ongoing records of how the system is working. This will help you in future planning.

Sample of a System Assessment Chart

Module 1			
Date	Activities	Assignments	Resources/Media

The Role of the Teacher in an Open-Learning Classroom

The teachers in a conventional classroom spend a lot of time talking to large groups of learners. The situation in open learning requires a different emphasis. Teachers will probably meet learners individually or in very small groups.

With this approach it is necessary to move beyond the idea of a passive learner depending largely on a continually supportive teacher. The teacher must aim to build the student's confidence, to stimulate the learner into self-reliance, and to guide the learner to take advantage of routes that are most meaningful and applicable to the learner.

These materials are student-centred, not teacher-centred. The teacher needs to facilitate learning by providing general support to the learner.

Evaluation

Evaluation is important to the development of every learner. Data gathering and processing, and decision making, at the student and teacher level, serve as means of identifying strengths and weaknesses.

These specially designed learning packages contain many kinds of informal and formal evaluation.

Observation

In the classroom the teacher has the opportunity to see each student perform every day and to become aware of the level and nature of each student's performance.

Observations are more useful if they are recorded in an organized system. The following list of questions is a sample of types of observations and how they can be collected.

Observation Checklist

	B. Adams	L. Despins	V. Klaissian	H. Smith	K. Dalley
1. Does the student approach the work in a positive manner?					
2. Is the student struggling with the reading level?					
3. Does the student make good use of time?					
4. Does the student apply an appropriate study method?					
5. Can the student use references effectively, etc.?					

Observation may suggest a need for an individual interview with a student.

Individual Conferences

Individual conferences may be paced (scheduled) by the calendar, at certain points in the module, or they may be set up only as needed or requested.

During these conferences teachers can determine the student's progress and can assess the student's attitudes toward the subject, the program, school, and self, as well as the student's relationship with other students. With guided questions the teacher can encourage oral self-assessment; the student can discuss personal strengths or weaknesses in regard to the particular section, module, or subject area.

Self-Appraisal

Self-appraisal helps students recognize their own strengths and weaknesses. Through activities that require self-assessment, students also gain immediate feedback and clarification at early stages in the learning process. Teachers need to promote a responsible attitude toward these self-assessment activities. Becoming effective self-assessors is a crucial part of becoming autonomous learners. By instructing, motivating, providing positive reinforcement, and systematically supervising, the learning facilitator will help students develop a positive attitude toward their own progress.

For variation, students may be paired and peer-assessing may become part of the system. The teacher may decide to have the student self-assess some of the activities, have a peer assess other activities, and become directly involved in assessing the remainder of the activities.

When the activities have been assessed, the student should be directed to make corrections. This should be made clear to students right from the start. It is important to note the correct association between the question and the response to clarify understanding, aid retention, and be of use for study purposes.

Many of the activities include choices for the student. If the student is having difficulty, more practice may be warranted, and the student may need to be encouraged to do more of the choices.

Each section within a module includes additional types of activities called Extra Help and Enrichment. Students are expected to be involved in the decision as to which pathway best suits their needs. They may decide to do both.

Self-appraisal techniques can also be introduced at the individual conferences. Such questions as the following might be included:

- What steps are you taking to improve your understanding of this topic?
- What method of study do you use most?
- How do you organize your material to remember it?
- What steps do you follow when doing an assignment?
- What could you do to become an even better reader?
- Do you have trouble following directions?
- Did you enjoy this module?

A chart or checklist could be used for recording responses.

Informal Evaluation: Assignments

Informal evaluation, such as the assignments included in each module, are an invaluable aid to the teacher. They offer ongoing assessment information about the student's achievement and the behaviour and attitudes that affect that achievement.

Each module contains a number of assignments. These assignments assess the knowledge or skills that the student has gained from the module. **The student's mark for the module may be based solely on the outcome of learning evident in the assignments; however, you may decide to establish a value for other variables such as attitude or effort.** It is important that you establish at the beginning which outcomes will be evaluated, and that all students clearly understand what is expected.

Final Test

All LFMs include a formal final test which can be photocopied for each member of the class. The test, closely linked to the learning outcomes stated in the module booklets, gives the teacher precise information concerning what each student can or cannot do. Answers, explanations, and marking guides are also included. The value of the final test and each module is the decision of the classroom teacher. Following is a suggestion only.

Module 1 **10%**	**Module 2** **10%**	**Module 3** **10%**
Module 4 **10%**	**Module 5** **10%**	**Module 6** **10%**
	Module 7 **10%**	
	Final Test **30%**	

Introducing Students to the System

Your initiation to these learning materials began with a basic survey of what was included and how the components varied. This same process should be used with the class. After the materials have been explored, a discussion might include the advantages and the disadvantages of learning independently or in small groups. The roles of the students and teacher should be analysed. The necessary progress checks and rules need to be addressed. Your introduction should motivate students and build a responsible attitude toward learning autonomously.

Skill Level

It is important for students to understand that there are certain skills that they will need in order to deal successfully with the course materials. They are listed below:

- understanding and using instructional materials (table of contents, index, list of illustrations, appendices, bibliography, and glossary)

- interpreting maps, graphs, and charts

- using reference materials

- recognizing special symbols

- using a scientific calculator

Other general skills are using reliable study methods, outlining, and learning to read at a flexible rate.

To decide the level and amount of instruction needed to accommodate the varied levels among students, you may wish to prepare and administer skill inventories or pretests. If most students need help with a particular skill, you may want to plan a total class instructional session. If only certain students lack a skill, you may want to set up a temporary skill group to help students who need it, or you may want to develop a skills file for this purpose.

Reading Level

These course materials are largely print based, but poorer readers need not be discouraged. It is important that you assure the students that these materials have been designed for easy reading. The authors have employed special strategies that lower and control the reading level. Some of them are

- the conscious selection of vocabulary and careful structuring of sentences to keep the materials at an independent reading level

- the integration of activities, examples, and illustrations to break text into appropriate-sized chunks

- the inclusion of many kinds of organizers (advance, graphic, intermediate, concept mapping, post organizers) to help give students a structure for incorporating new concepts

- the recognition that vocabulary and concepts are basic to understanding content materials and, thus, must be handled systematically (defined in context, marginal notes, footnotes, and often in a specialized glossary)

- the acknowledgement that background knowledge and experience play a vital role in comprehension

- the systematic inclusion of illustrations and videos to help poorer readers and visual learners, and audiocassettes and software as an alternative to print-based learning

- a variety of formats (paragraphs, lists, charts, etc.) to help poorer readers who do not absorb or retain main ideas easily in paragraph format

- the inclusion of media and activity choices to encourage an active rather than passive approach

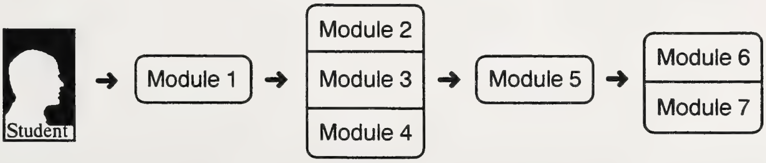
- instruction in a meaningful setting rather than in a contrived, workbook style

- using purposeful reading, viewing, and doing to produce better interpretation of the course materials

- the recognition that students need structured experiences when reading, viewing, or listening to instructional materials: developing pupil readiness, determining the purpose, providing guided instruction and feedback, rereading if necessary, and extending (This structure closely resembles the reading process.)

To help make the learning package more readable, you can begin your module preparation by reading (viewing, listening to) all the related materials that are going to be used. You need a solid background in order to assess and develop a background knowledge for students. The students' experiential bases may be assessed through brainstorming sessions concerning the topic, or by using visuals and guided questions to predict what the topic might be about.

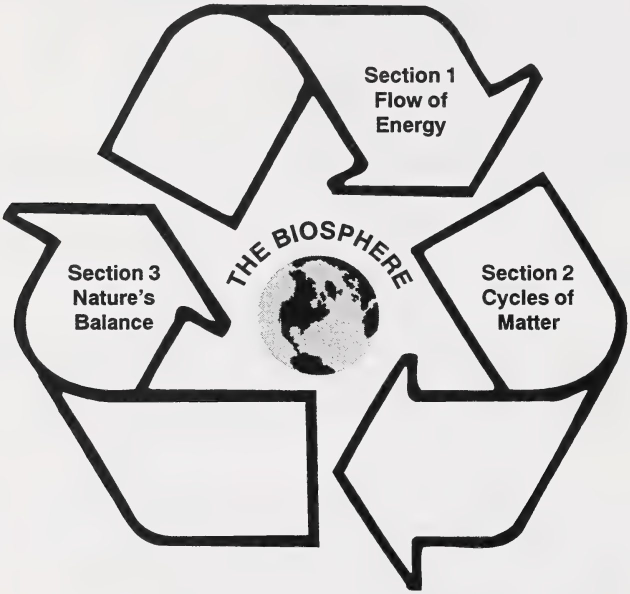
It is recommended that you start with Module 1 because this module includes basic introductory information, and it is also recommended that you end with Module 7 because this module acts as a summary or culmination.



Module 1: The Biosphere

Overview

The focus of this module is the dynamic equilibrium that exists in the biosphere. A constant flow of energy and a perpetual cycling of matter can be influenced by humans. The past has seen widespread disruptions to the balance in nature, but the future can restore the delicate steady state. Students are invited to accept the challenge of making a positive contribution to the well-being of the environment. The goal of this module is to help students understand the mechanisms that contribute to a healthy biosphere.



Evaluation

The evaluation of this module will be based on three assignments:

Section 1 Assignment	**30 marks**
Section 2 Assignment	**40 marks**
Section 3 Assignment	**30 marks**
TOTAL	**100 marks**

Science Skills Assessment

This module contains a methodology for the assessment of science skills. Assessment is performed by both the student and a teacher-marker. An explanation of skill assessment is given in the introduction of each student module. A more complete explanation may be found in *A Model for the Assessment and Evaluation of Scientific Problem-Solving Skills* from Student Evaluation Branch, Alberta Education. A further reference, *Performance Assessment Banks, Activities, and Instruments* produced by the Instructional Technology and Media Unit of the Alberta Distance Learning Centre is recommended.

Materials and Equipment

The following is a list of the supplies and equipment necessary to complete the investigations and activities in Module 1. Some investigations are optional. Learning facilitators are advised to examine the investigations prior to acquiring materials.

Section 1: Activity 3

- 20 bean seeds, 20 pea seeds, 20 corn seeds
- balance beam
- 6 petri dishes
- paper towelling
- light site and dark site

Section 1: Activity 4

- 3 Thermos bottles
- cotton wool
- 6 Styrofoam cups
- 3 thermometers
- tape
- 40 pea seeds

Section 2: Activity 2 – Part A

- razor blade and wire
- plants with leaves (e.g., tomato)
- pipettes
- rubber tubing
- fans
- ring stands and clamps

Section 2: Activity 1

- balance beam
- plant with leaves
- test tube
- cotton ball
- 250 mL beaker (just to hold test tube)
- 10 mL graduated cylinder
- metric ruler
- scissors
- masking tape

Section 3: Activity 1

- large bottle or jar with lid (3-4 L)
- light source (60 W)
- plant-eating fish (Guppies are great.)
- aquatic plants
- clean gravel or sand
- pond snails
- dechlorinated water (standing tap water or rain water)

Resources

The Atmospheric Environment Service of Environment Canada have some excellent publications available to provide students with real data.

- Canadian Climate Normals
  Volume 1 Solar Radiation 1961-1990
  Volume 7 Bright Sunshine 1961-1990
  ISBN 0-660-51810-4

  Canadian Government Publishing Service
  Supply and Services Canada
  Ottawa, Ontario
  K1A 0S9

Also the students can phone the Weather Office in the following locations for information about hourly and daily sunshine.

- Coronation
- Edmonton International Airport
- Edmonton Municipal Airport
- Grande Prairie Airport
- Jasper
- Lethbridge Airport
- Edson
- Slave Lake Airport
- Fort McMurray Airport

For information about the storage of energy in plants and animals, contact the following resource people.

Darren Chase or Matthew Machielse, Research Assistants
Production Economics Branch
Agriculture Alberta
3rd Floor, 7000 - 113 Street
Edmonton, Alberta
T6H 5T6
Phone: 427-4005

The Environment Council of Alberta has published some excellent resources on waste management, clean air strategies, and climate warming. These resources will provide students with local data that is current and applicable.

- *Resource Recycling in Alberta*
  ECA 85-18/1B1
- *Recycling of Waste in Alberta*
  ECA 87-18/RR1
  ECA 87-18/RR2
  ECA 86-18/B1B
- *Climate Warming? Exploring the Answers*
  ECA 90-ST/1
- *Alberta's Clean Air Act*
  ECA 86-ST/1

Contact:
Environment Council of Alberta
8th Floor Weber Centre
5555 Calgary Trail Southbound NW
Edmonton, Alberta
T6H 5P9
Phone: 427-5792

Reference is also made to the laser videodisc *The Living Textbook* available from the following address:

Optical Data Corporation
30 Technology Drive
Warren, NJ 07059
USA
Phone: 1-800-267-7788

Additional Resources

Andrews, William A. 1986. *Investigating Terrestrial Ecosystems*. Scarborough, Ontario: Prentice-Hall Canada, Inc.

Biggs, Alton L. 1991. *Biology: The Dynamics of Life*. Columbus, Ohio: Merrill Publishing Company.

Carson, Walter H. 1990. *The Global Ecology Handbook*. Boston, Massachusetts: Beacon Press.

Johnson, Lorraine. 1990. *Green Future*. Markham, Ontario: Penguin Books.

Monger, Grace. 1986. *Revised Nuffield Advanced Science*. Essex, England: Longman Group Limited.

Perceptix: A Monthly Review of Interactive Learning Technology. Contact Perceptix at 1-800-267-7788.

Media Resources

The following is a mandatory video for Module 1:

- *Global Warming, Hot Times Ahead*

The following are optional videos for Module 1:

- *Energy and the Food Web*
- *Planet Under Pressure: Ozone*
- *Recycling: The Endless Cycle*
- *Water: A Fascinating Liquid*
- *Creatures of the Pond*
- *Water in Alberta: The Living Flow*

Section 1: Flow of Energy

The biosphere is maintained by a constant flow of energy from the sun. Solar radiation is investigated and students have the chance to learn about where and how this data is collected. Also, the Laws of Thermodynamics are presented to lay a foundation for the module. A representative from the Atmospheric Environment Service of the Federal Government would be an excellent resource as a guest speaker. A field trip to the Weather Office would also enhance this section.

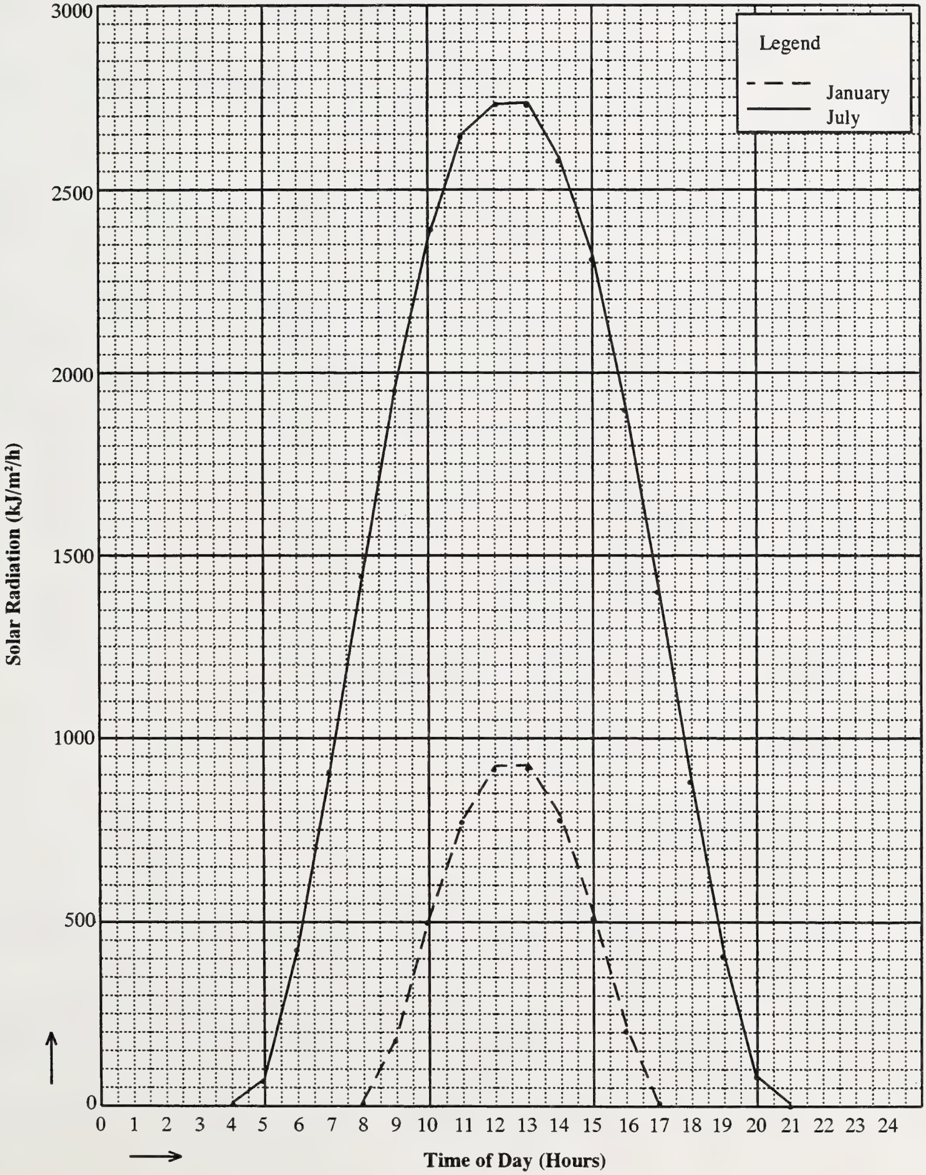
Section 1: Assignment Answer Key (30 marks)

1. Since daylight hours are reduced by half, only half as much energy will be available for photosynthesis. Photosynthesis will be reduced by half, and only half as much energy will be captured and available for transfer to other organisms. **(1 mark)**

2. Farmers can enhance profits by ensuring maximum productivity from available energy. Whether it is grain, dairy, poultry, or livestock production, farmers can maximize the efficiency of production by reducing losses as heat and balancing input and output of energy. **(1 mark)**

3. Global Solar Radiation includes the total incoming solar radiation (direct and diffuse). The Net Radiation includes downward and upward radiation (solar, terrestrial, and atmospheric), that is radiation directly from the sun but also radiation reflected by the soil. **(2 marks)**

4. a. Title: Solar Radiation Comparison **(3 marks)**



b. The average hourly solar radiation is calculated by dividing the total hourly solar radiation by the number of hours of sunlight. **(2 marks)**

$$\text{January} = \frac{4936}{10} = 493.6\ \text{kJ/m}^2\text{/h}$$

$$\text{July} = \frac{25\ 056}{18} = \sim 1392\ \text{kJ/m}^2\text{/h}$$

c. There is more direct sunlight in July as well as more daylight hours per day because the northern hemisphere is tilted toward the sun in the summer. **(2 marks)**

d. There is more solar radiation available to plants in Alberta based on the data given. Therefore, the energy conversion should be higher on an Alberta wheat farm. **(1 mark)**

e. Halifax, Nova Scotia is farther south than Churchill, Manitoba. **(1 mark)**

f. For Churchill, Manitoba to increase its productivity, different species of wheat need to be grown that have a higher energy conversion efficiency. Also milder temperatures are needed, so less energy is lost by the wheat in respiration. **(1 mark)**

5. The First Law states that energy can neither be created nor destroyed, but it can be transformed. Photosynthesis is an excellent example of a transformation. Solar radiation is converted into chemical energy. The Second Law states that each time energy is transformed, there is usually some energy lost as heat. Cellular respiration is an example of this law. The metabolic heat is lost into the atmosphere. Students will probably indicate that photosynthesis serves to capture and transform energy while respiration serves to convert energy. During each transformation or conversion, some energy is lost as heat. **(4 marks)**

6. Both processes are performed by living organisms and involve energy transformations. The products of one process are the reactants of the other and vice versa. **(2 marks)**

7. a. Plants trap $\frac{42\ 872}{2\ 093\ 400} = \sim 2\%$ of energy. **(1 mark)**

b. The energy available to cattle is 42 872 – 3936 = 38 936 kJ/m^2. **(1 mark)**

c. The albedo or reflectivity of the leaves is $\frac{330\ 004}{2\ 093\ 400} = \sim 0.16$ or 16%. **(1 mark)**

d. One cow receives $\frac{6\ 102}{42\ 872} = \sim 14\%$ of the energy. **(1 mark)**

e. You only receive $\frac{250}{6\ 102} = \sim 4\%$ of the energy. **(1 mark)**

f. The farmer could make more energy available by removing the decomposers and other herbivores. Also, the farmer could get the cow to eat all of the plants. By reducing the energy lost, the farmer could increase the energy conversion efficiency as well. This could be done by keeping the cattle warmer and by making it easier for the cattle to obtain food. **(2 marks)**

g. The plants may contain more energy because they receive more and lose less in the stable environment of tropical regions. Native herbivores will be better adapted to the conditions and the newcomer cattle will lose more energy in search for food, competition for food, and adaptation to the heat. **(2 marks)**

h. The energy conversion efficiency is higher in herbivores than carnivores. Students may refer back to data from Activity 2 comparing battery farm chickens to cats. **(1 mark)**

Section 2: Cycles of Matter

The emphasis in this section is that natural resources cycle in the biosphere and are limited. Students should understand which elements are essential for life and how these elements travel through the biosphere. Again, the impact of human activity is investigated and students can identify viable solutions to problems that are created. A visit to a water treatment facility in your area can introduce this section. Also having students investigate water usage at your school would give practical insight.

Section 2: Assignment Answer Key (40 marks)

1. The biosphere is a closed system with a fixed amount of raw materials. A source of new compounds is simply not available, so matter must be recycled through living organisms. **(1 mark)**

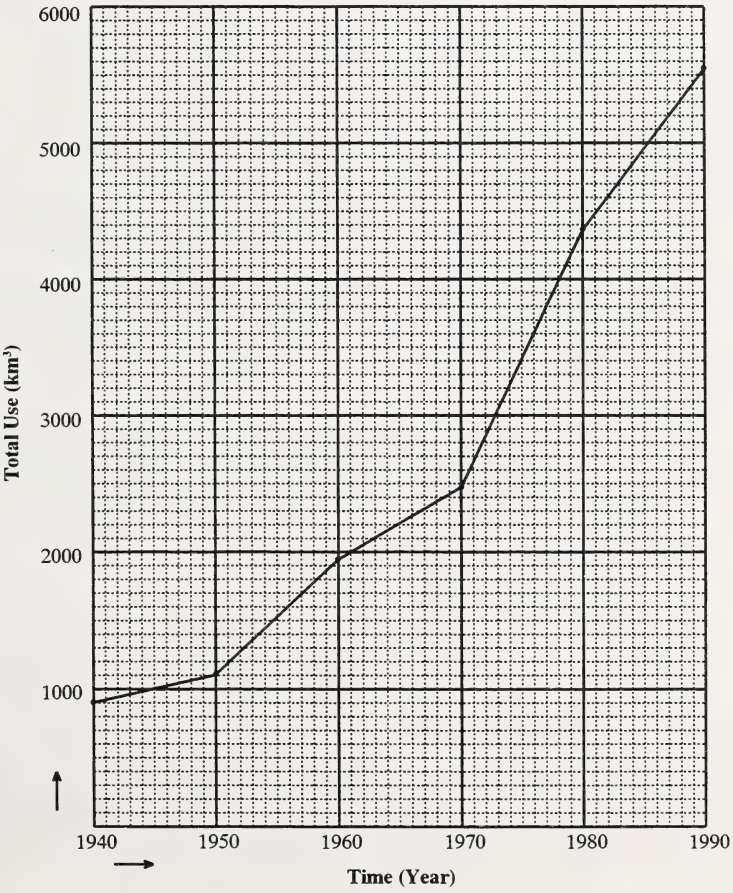
2. Effective waste management employs four processes: reduce, reuse, recycle, and recover. Reducing waste will allow the cycles of matter to proceed more normally because human waste products often require more time to decompose. Reusing, recycling, and recovering will keep constant the portion of raw materials that are removed from the cycles for human use. **(4 marks)**

3. In the carbon-oxygen cycle, water is a reactant in photosynthesis and a product in cellular respiration. It also acts as a solvent in the atmosphere and in the oceans for CO_2 and O_2. Water is a solvent and transport medium for nitrates in the nitrogen cycle and phosphates in the phosphorus cycle. **(3 marks)**

4. When water evaporates, all of the substances dissolved in the liquid remain behind. It is only the water molecules that escape. In this way, water becomes pure again. **(1 mark)**

5. When water evaporates it moves to higher elevations and falls to the ground. As water flows from higher elevations to lower ones, electric energy can be produced. **(2 marks)**

6. a. Title: World Water Use **(3 marks)**



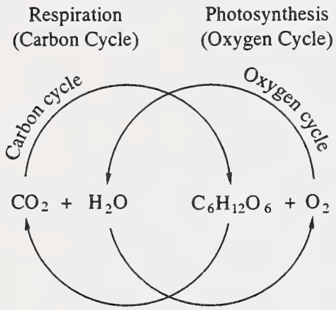
b. The total world use predicted for the year 2000 would be approximately 7000 km^3. Students' answers may range from 6000 to 7600 km^3. **(1 mark)**

c. Reasons for increased demand may include the following:

- increased population
- increased agriculture
- increased industry
- increased pollution (waste disposal)
- increased energy production **(3 marks)**

d. The major return process is evaporation, although transpiration and respiration do contribute to the amount of water vapour. After water has been used by humans, it is returned to the soil or water supply. **(2 marks)**

7. The carbon and oxygen cycles utilize the processes of photosynthesis and respiration. Carbon dioxide is the key to both cycles. Students may add an equation like the following:



(2 marks)

8. When the fossil fuel burns, the carbon atoms become CO_2 in the air. As CO_2, the carbon atom will become a part of carbohydrates during photosynthesis in plants. The plant sugars are eaten, digested, and transported to body cells by humans. Cellular respiration releases the carbon atoms as CO_2 which is exhaled. **(4 marks)**

9. Increased combustion of fossil fuels for energy adds CO_2 to the atmosphere. Increased animal populations (including humans) add CO_2 to the air through cellular respiration. Reduced numbers of trees from industrial use and burning will keep CO_2 levels high because less photosynthesis can occur. Increased decomposition of dead, organic matter adds CO_2 to the atmosphere. Pollution of oceans reduces photosynthetic organisms and keeps CO_2 levels of the air high. More CO_2 in the air retains heat increasing global warming. **(6 marks)**

10. a. Inorganic nitrogen in the soil (Arrow A) is absorbed with water by the roots of the tree. When the leaves fall (Arrow B), bacteria begin to decompose them and add to the organic nitrogen in the forest floor. Ammonification (Arrow C) will convert organic nitrogen in the forest floor litter into organic nitrogen in mineral soil. Nitrification (Arrow D) will produce inorganic nitrogen in the soil as nitrates. **(4 marks)**

b. Nitrogen fixation by bacteria adds nitrogen to the soil as nitrates. Denitrifying bacteria remove nitrogen from the soil and replace it in the air. **(2 marks)**

11. Phosphates in organisms must first be released by decomposition. Then they can dissolve in water and be made available to organisms again. This is the shortest process. The long route would occur if the phosphate was trapped in sediments. Many years later, geological uplift and erosion could free the phosphate to water and it would be available to organisms again. **(2 marks)**

Section 3: Nature's Balance

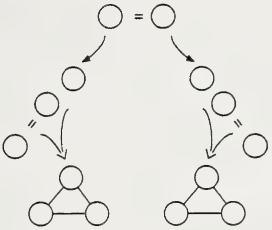
The quality of air is diminishing rapidly around the world. The concept of balance is reinforced at the start to give students a vision of success when dealing with atmospheric disruptions. Ozone depletion and increased global warming (a function of the greenhouse effect of the atmosphere) are presented. As students become active in solving these problems, the goal for this section will be achieved. Exploring renewable energy sources is a very positive way to approach this section.

Section 3: Assignment Answer Key (30 marks)

1. First, the dome must be transparent to allow sunlight to reach the vast quantities of plants that can photosynthesize. The production of oxygen can be circulated throughout the city. Carbon dioxide must be circulated to the plants along with water, which is condensed along the dome by a cool air flow. Solar radiation must be the main source of energy; therefore there is no pollution. Nutrients must be recycled by vast composting areas, which contain all the necessary bacteria. Waste must be reduced, reused, recycled, and recovered efficiently. If a constant energy source and efficient cycling of matter occurs, the domed city can work. **(8 marks)**

2. Ozone is formed when ultraviolet light strikes oxygen molecules making them highly reactive. A single atom will bond with a pair to produce a new triplet molecule called ozone (O_3). Students may add an equation or a diagram. **(3 marks)**

$3\,O_2 \rightarrow 2\,O_3$



Ozone

3. CFCs break down in the stratosphere and release chlorine atoms. These reactive atoms split ozone molecules into oxygen molecules (O_2). Other pollutants will also break down ozone the same way. The problem is a result of the free chlorine continuing its destructive work. **(3 marks)**

4. An ozone hole allows increased UV radiation to reach the Earth. This will damage plant and animal cells, as well as cause mutations. The plants used in agriculture in Alberta will decrease in quantity and quality as a result of this hole. Humans will be affected in the following ways:

    - chronic aging of the skin
    - acute sunburns
    - eye disorders
    - nutritional deficiencies
    - skin cancer
    - infectious disease **(5 marks)**

5. Carbon dioxide is the most abundant greenhouse gas because of combustion of fossil fuels and plant and animal respiration. **(1 mark)**

6. The greenhouse gases should be reduced in the following order:

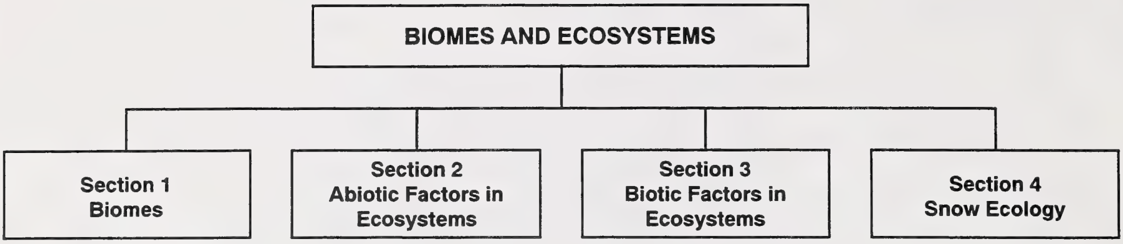
    - carbon dioxide
    - methane
    - nitrogen oxides
    - CFCs

    In this way, you will start with the most abundant greenhouse gas and have the greatest impact at the beginning. Carbon dioxide levels can be reduced by decreasing fossil fuel combustion and by increasing reforestation practices. CFCs will decrease when coolants are recycled and new technology produces ozone-friendly coolants. Methane can be reduced with better waste management. More efficient use of renewable energy resources will reduce exhaust emissions containing nitrogen oxides. Also, reducing the use of fertilizers in agriculture will halt increasing levels of nitrogen oxides. **(10 marks)**

Module 2: Biomes and Ecosystems

Overview

The main focus in this module is that the biosphere is composed of a variety of biomes, each with distinctive biotic and abiotic factors. It is divided into four sections. The first section looks at what a biome is and how it fits in with the rest of the biosphere. The abiotic factors (physiographic, climatic, edaphic) and biotic factors are discussed for the biomes found in Canada. The second section examines the exchange of matter and energy that contributes to the existence of the biosphere's major biomes. Abiotic factors of a terrestrial and aquatic ecosystem are investigated. In the third section biotic factors are investigated through gathering and analysing data on the diversity of plant, animal, and decomposer species. In the last section an examination of snow and ice as abiotic factors and hypothesizing about their ecological role is discussed. A STS connection in this section looks at evaluating the possible impact that modern human activity has on ecosystems.



Evaluation

The evaluation of this module will be based on four assignments:

Section 1 Assignment	**25 marks**
Section 2 Assignment	**25 marks**
Section 3 Assignment	**25 marks**
Section 4 Assignment	**25 marks**
TOTAL	**100 marks**

Materials and Equipment

The following is a list of supplies and equipment necessary to complete the investigations and activities in Module 2.

Section 2: Activity 1

- reinforced thermometer
- litmus paper (red and blue)
- 10 mL graduated cylinder
- wire coat hanger
- 100 mL distilled water
- 2 blocks of paraffin wax
- wire cutters or pliers
- 4 test tubes
- aluminum foil
- mineral oil
- 4 small funnels
- elastic bands
- shovel

Section 2: Activity 2

- tin foil
- test tube
- thermometer
- test tube brush
- methylene blue
- hardness scale
- 250 mL beaker
- 250 mL flasks (4)
- medicine dropper
- 10 m of fishing line or string
- pH paper with pH scale
- stoppers for flasks
- hardness testing paper
- 10 mL graduated cylinder

Section 2: Enrichment

- 15 pea seeds
- 3 planting boxes
- potting soil
- 3 thermometers

Section 3: Activity 1

- bucket
- dip net
- rubber boots and rubber gloves
- a field guide of trees and scrubs
- 5 collecting jars
- hand lens
- notepad and pencil
- compound microscope

Resources

- The Hach Chemical Company makes available a wide variety of water test kits. Write to the following address for their catalogues:

  Hach Chemical Company
  P.O. Box 389
  Loveland, Colorado
  80539 USA

Hach materials and information are available from aquatic chemical companies in Alberta such as

Prairie Chem Inc.
1919 – 84th Avenue
Edmonton, Alberta
T6P 1K1
Phone: 467-4043

- *The Aquatic Invertebrate Monitoring Program.* This program is available from FEESA via Alberta Education, Curriculum Branch.

Additional Resources

Andrews, William A. 1986. *Investigating Terrestrial Ecosystems.* 2nd Edition. Scarborough, Ontario: Prentice-Hall Canada, Inc.

Galbraith, Don. 1993. *Biology Directions.* Toronto, Ontraio: John Wiley and Sons Canada Limited.

Ritter, R., Drysdale, B., and Coombs, D. 1987. *Biology, A Canadian Laboratory Manual.* Agincourt, Ontario: GLC Silver Burdett Publishers.

Ritter, R. and Samiroden, W. 1993. *Teacher's Resource to Nelson Biology.* Scarborough, Ontario: Nelson Canada.

University of Alberta. *Common Pond Invertebrates of the Edmonton Area: A Teacher's Guide*: Edmonton, Alberta: University of Alberta Press.

Media Resources

The following is an optional video for Module 2:

- *This Living World, Volume 2: The Forest*

Other possible media should be available from organizations such as C.A.M.S. – Central Alberta Media Services. Many videos are available on aquatic ecosystems. Encourage students to look for abiotic and biotic factors and emphasize the flow of energy and cycles of matter.

Note: Some of the suggested media may not be authorized by Alberta Education. Teachers should use their own discretion regarding the use of these resources in their classrooms.

Section 1: Biomes

The emphasis in this section is for students to be able to define the term *biome* and gain understanding of the various abiotic and biotic factors making up the major biomes. The impact of the human species on forest biomes is studied. Classroom visits by an ecologist or environmentalist could be used to enhance this section. Students are encouraged to get outside and explore the biome in which they live.

Section 1: Assignment Answer Key (25 marks)

1. The biosphere is defined as the area on Earth where life exists. A biome is a component of the biosphere with a characteristic climate and dominant vegetation. **(3 marks)**

2. For abiotic factors, any two of the following are acceptable:

   - physiography
     - topography
     - location → altitude, latitude
   - climate in terms of temperature
   - precipitation in type and amount

For biotic factors, accept the following:

- dominant vegetation
- type of animal life

Students should compose their answer and may give examples. Climate would be described as warm or cold and wet or dry. Geographic factors may be mentioned such as latitude, altitude, coastal, or continental. Biotic factors will be distribution and type of plants and animals. **(4 marks)**

3. From coldest to warmest, the biomes are tundra, boreal coniferous forest, mixed woodland forest, temperate rainforest, chaparral, and desert. **(3 marks)**

   Note: Mixed woodland forest and temperate rainforest are interchangeable since they are at approximately the same latitude.

4. - boreal forest: coniferous trees
   - chapparal: broad-leafed evergreen shrubs or dwarf trees not over 2.5 m tall
   - desert: xerophytes (annuals, succulents, and shrubs)
     Note: Most students will give cacti as an answer, which is an example of a succulent.
   - mixed woodland forest: deciduous trees
   - temperate rainforest: giant conifers
   - tundra: rapid flowering plants or mosses and lichens **(3 marks)**

   The order of the answers may follow the order in question 3 or the order from the student's answer 3.

5. A mountain biome is a collection of different biomes because it has different altitudes. The effect of altitude is similar to latitude in that as it increases in value, the biomes change to reflect less precipitation and colder climate. **(2 marks)**

6. The temperatures and plant life decrease as you move further from the equator or increase altitude. **(2 marks)**

7. Any three of the following are acceptable:

   - provide medicines
   - provide paper products
   - supply oxygen through photosynthesis
   - provide lumber for fuel and building
   - provide rubber products (shoes, tires)
   - provide various types of food **(3 marks)**

8. The main reason for this destruction is money and the need for space. Individuals who are poverty-stricken will slash and burn to clear land to support their families by farming or raising cattle. **(3 marks)**

9. One possibility is to allow individuals to earn income through reforestation of the rainforests. Individuals need to be educated about deforestation and reforestation. Alternative areas for farming or cattle grazing need to be found. **(2 marks)**

   Note: The intent of this question is to have students think of ways to help the situation, so other solutions may be offered.

Section 2: Abiotic Factors in Ecosystems

The biome concept is extended into Section 2 by looking at how biomes are formed. The major concept in this section is abiotic factors. Students should first become familiar with what abiotic means and be able to identify various abiotic components. They should be able to understand how abiotic factors (energy and matter) contribute to the formation of the different biomes in the biosphere. The end of the section examines human impact on abiotic factors and the effects of this impact.

Section 2: Assignment Answer Key (25 marks)

1. a. Site 1 is the ecotone between sites 2 and 3. This is the ecotone because all of its values are in between the values for the other two sites. **(3 marks)**

b. Site 2 would most likely be the forest region. Any two of the following reasons are acceptable:

- Site 2 has cooler temperatures than the other two areas, thus indicating that it is more shaded.
- Relative humidity is highest at Site 2 indicating that it has a high moisture content due to the cooler temperatures.
- Evaporation rate is lowest because of cooler temperatures.
- Wind velocity is the lowest due to the sheltering of trees.
- Light is lowest due to shading of trees. **(5 marks)**

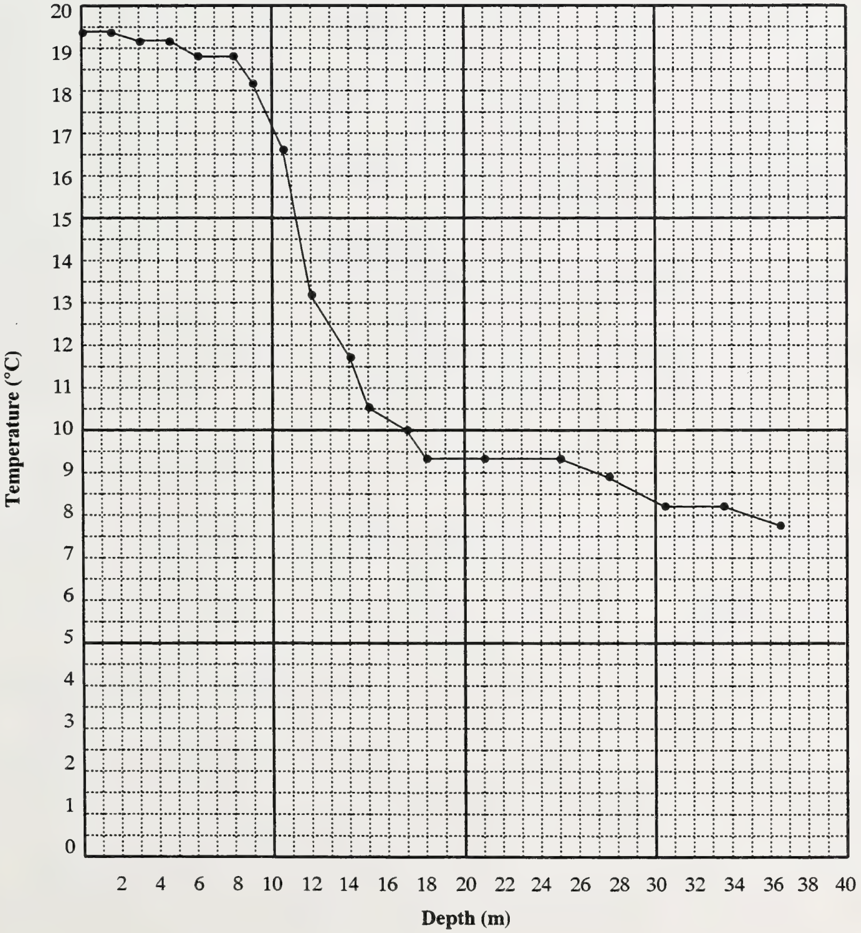
c. Any two of the following are acceptable; other variables may be described.

- Measurements were taken at the same time of day.
- Measurements were taken at the same height above the ground, assuming the level in the treed sites was the same.
- The same type of measuring device was used for all three sites. **(2 marks)**

2. A number of measurements is more valid or more accurate. If only one measurement is taken it may not be a true reflection of what that site should really be for that particular measurement. Error is reduced by taking multiple measurements. **(2 marks)**

3. a.

TEMPERATURES AT VARIOUS DEPTHS IN FRESHWATER



(4 marks)

b. As the depth increases, the temperature decreases. **(2 marks)**

c. The greatest concentration of dissolved oxygen occurs at depths of 6.0 and 12.0 m. **(1 mark)**

d. It decreases. **(1 mark)**

4.
- more protected grassland areas
- more protected areas for prairie wetlands – prevent extinction of wildlife (waterfowl)
- water conservation – drinking, irrigation
- reduce polluting of freshwater **(3 marks)**

Note: The intent of this question is to have students think of ways to help the situation and to recognize that each person can make a contribution. Other actions may be offered. They may be acceptable on the basis of being practical.

5. The grasslands will be replaced by desert. The abiotic factor which will cause this change will be the lack of moisture. This may be related to an increase in temperature. **(2 marks)**

Section 3: Biotic Factors in Ecosystems

In this section students investigate biotic factors in various ecosystems. The major emphasis here is the gathering and analysing of data on the diversity of plant, animal, and decomposer species in an aquatic and terrestrial ecosystem. Students should be able to describe the biotic structure in a ecosystem. They should come to realize that ecosystems differ in terms of species composition (types of species present), species diversity (different types of species present), species abundance (numbers of individuals of a species), and species distribution (where they live in the ecosystem). This represents the biotic structure of the ecosystem. The end of the module looks at human impact on the biotic components of the ecosystem. By this time, students should see a relationship between the abiotic factors and the biotic factors. This relationship involves abiotic factors influencing the biotic factors which form ecosystems. Depending on what happens to the abiotic factors, the biotic factors will react positively or negatively which causes changes in the ecosystem.

Section 3: Assignment Answer Key (25 marks)

1. a. Five abiotic factors could include hot summer temperatures, low precipitation, intense sunlight, high winds, sandy soils, rocky soils, fairly flat land, and others. All should relate to a grassland biome. **(5 marks)**

   b. Biotic factors could include grasses, cactus, low shrubs, a few trees near water, snakes, ground squirrels, skunks, weasils, jackrabbits, badgers, antelope, burrowing owls, and many other grassland birds. All should relate to a grassland biome. **(5 marks)**

2. Any six of the following are acceptable:

   Paramecium, Euglena, Vorticella, Amoeba, Stentor, Cyclops, Volvox, Daphnia. Students may name any algae or protozoans. **(3 marks)**

3. a. Any two of the following are acceptable: bullrushes, cattails, burreeds, reeds, sedges **(1 mark)**

   b. Any two of the following are acceptable: water strider, whirling beetle, water spider, springtail, algae, water lilies, smartweeds, pondweeds, duckweeds **(1 mark)**

   c. Any two of the following are acceptable: diving beetle larvae, nematodes, scuds, leeches, stone flies, damselfly nymphs, dragonfly nymphs, mayfly nymphs, caddis fly larvae, snails, waterweeds, waterbuttercups, cattails, pondweeds **(1 mark)**

4. Any two of the following are acceptable:

   - species composition – Ecosystems can differ in terms of the types of species, that is different kinds of plants and animals.
   - species diversity – Ecosystems can differ in the number of types of species.
   - species distribution – Ecosystems can differ in where the species are found (e.g., nests found in trees or on the ground).
   - species abundance – Ecosystems can differ in the number of individuals of a species.

   Students may compose a simpler answer such as a difference in the numbers and kinds of producers, consumers, and decomposers. **(4 marks)**

5. Any two of the following factors will enhance biological diversity in an ecosystem:

   - increasing space for organisms to live
   - increasing food for a diverse array of organisms
   - increasing the variety of habitats for organisms **(2 marks)**

6. Any three of the following are acceptable:

   - through agriculture by clearing the land, reducing the ecosystem space, and growing monocultures

   - through forestry by clearing the land, reducing the ecosystem space, and replanting only single species

   - through industrial pollution creating acid rain which damages aquatic and terrestrial ecosystems and impacts different species

   - through intense harvesting of single types of organisms such as cod fishing

   - through the release of toxic contaminants which result in death of many organisms

   - through introducing, accidentally or intentionally, new species into an ecosystem which may result in disease, competition, and other negative influences to the native species

   - through the burning of fossil fuels which enhance the greenhouse effect leading to global warming **(3 marks)**

Section 4: Snow Ecology

In this final section, students should be able to reinforce the idea of interaction between abiotic and biotic components in a snow ecosystem. The emphasis is to have students gather data on the nature of snow and ice as abiotic factors and examine their ecological role.

Section 4: Assignment Answer Key (25 marks)

1. Temperature: It is warmer at the bottom than at the top. This is because there is better insulation closer to the bottom. The heat is kept near the ground.

   Type of crystals: The bottom crystals are the shape of ball bearings. The top crystals are less round and more crystalized; yet they are still snowflakes. This is due to sublimation. The bottom snow loses projections as crystals thaw and refreeze.

   Insulation: There is less insulation at the top than at the bottom of a snowpack. This is due to greater depth of snow. **(9 marks)**

2. As the snow crystals lose their projections, air spaces that trap heat are reduced. Also, the snow crystals become ball shaped and pack together more tightly. **(3 marks)**

3. Trapped heat warms the bottom layer of the snow. Sublimation occurs as snow near the ground evaporates. The water vapour moves upwards. This creates open spaces at the bottom along the ground. **(3 marks)**

4. a.
   - small protuding body parts such as shorter ears and limbs
   - formation of adipose (fat) tissue
   - coat of fur gets thicker
   - formation of hair as a warm inner layer and outer protective layer
   - change in coat colour **(1 mark)**

   b.
   - counter current exchange circulation **(1 mark)**

   c.
   - Animals seek protected or shelter areas to conserve heat.
   - Animals spend more time under trees (insulation). **(1 mark)**

5. Chionophobes may migrate, hibernate, freeze, or supercool body fluids or convert them into antifreeze. **(3 marks)**

6. If the snow cover is lost or the pukak layer destroyed, the animals would be exposed to freezing temperatures, cut off from food supplies, and exposed to predators. **(2 marks)**

7.
   - Mammal crosses barrier and survives.
   - Mammal moves out of layer and become prey to a waiting predator.
   - Mammal moves out of layer and freezes to death because body cannot survive cold temperature. **(2 marks)**

Module 3: Matter and Energy in Ecosystems

Overview

The major concept developed in this module is that ecosystems have characteristic structures determined by their energy and matter exchange. This module develops student ability to use skills and thinking processes associated with the practice of science, emphasizing the following:

- analysing quantitative data on food chains and webs
- connecting, synthesizing, and integrating the energy and matter exchange in ecosystems
- predicting the future outcomes of those ecosystems

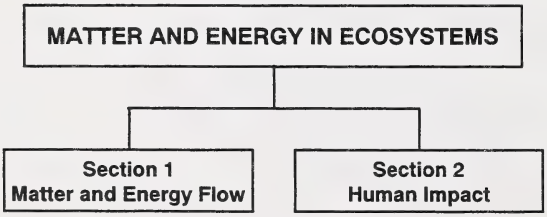
The STS connections in this module illustrate

- the inability of science to provide complete answers to all questions

- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations

In this module students will be encouraged to develop the following attitudes:

- appreciate the diversity of ecosystems
- value the knowledge that all organisms have an important role in maintaining the life of the planet
- develop an awareness of one's personal role in the preservation of the environment
- develop a sense of responsibility toward use of the environment
- appreciate the multidimensional nature of science, technology, and societal issues
- appreciate the contributions and limitations of scientific and technological knowledge to societal decision making
- value the necessity of being adaptable to changes in the environment



Evaluation

The evaluation of this module will be based on two assignments:

Section 1 Assignment	**50 marks**
Section 2 Assignment	**50 marks**
TOTAL	**100 marks**

Materials and Equipment

The following is a list of supplies and equipment necessary to complete the investigations and activities in Module 3.

Section 1: Enrichment

- stopwatch
- meter stick
- shovel
- hand lens
- 3 thermometers (reinforced)
- black cardboard

Resources

- *Common Pond Invertebrates of the Edmonton Area. A Teacher's Guide.* Published by the Friends of the Garden. University of Alberta Devonian Botanic Garden, 1990.
- *Guide to the Common Native Trees and Shrubs of Alberta.* Edited by Wayne Inkpen. Alberta Environmental Protection Services.
- *Wetland Environments: Investigations in the World of Waterfowl* (Science Curriculum Unit.) Ducks Unlimited, Edmonton, Alberta.
- Natural Region Posters. Available from Environmental Education Coordinator Provincial Parks Service, Alberta Recreation and Parks. (An order form is provided following the Media Resources list.)

Media Resources

The following are mandatory videos for Module 3:

- *Aspects of Ecology: Ecosystems*
- *Aspects of Ecology: Circles and Cycles*
- *If You Build It*
- *The Athabasca: A Case Study*

NATURAL REGIONS POSTERS ORDER FORM

You may order individual posters or the complete set. Please note that the manual describes the physical features, plants and animals found in the posters and suggests activities.

The posters cost $3.00 each and the manual costs $20.00. If you wish to purchase a full set of five posters and manual, you pay only $25.00 per package. The 7% GST is payable on all materials. Please add 21 cents for each poster and $1.40 for each manual ordered for GST. The GST for the package is $1.75.

I would like to order the following posters and manual:

POSTER	NUMBER	COST	TOTAL
Aspen Parkland			
Northern Forest			
Central Foothills			
Grasslands			
Rocky Mountains			
Manual			
All 5 posters and manual			

Total Amount of Posters	$ ________
Total Amount for Learning Resources Manuals & Park Chapters (over)	$ ________
****G.S.T. (total amount × 7%)**	$ ________
Total Amount *	$ ________

Mail Learning Resources Manuals, Park Chapters and Posters to:

Name: ____________________
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City/Town: ____________________
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Phone Number: ____________________
School or Organization: ____________________

Make Cheques or Money Order Payable To: Provincial Treasurer

Mail Orders To: Environmental Education Co-ordinator
Provincial Parks Service
Alberta Recreation and Parks
Standard Life Centre
10405 Jasper Avenue
Edmonton, Alberta
T5J 3N4

***Prices subject to change without notice.**

**** G.S.T. Registration #R 124072513**

Section 1: Matter and Energy Flow

The emphasis in this section is on how matter and energy flow through ecosystems in a dynamic way. Trophic structure is examined along with energy pathways. Pyramids of numbers, biomass, and energy are introduced in this section. Further examination of the quantitative examination of trophic pyramids occurs in Section 2.

Section 1: Assignment Answer Key (50 marks)

1. a. The flow of energy is similar in both ecosystems in that energy is captured by plants (producers) and passed to either deer or cattle (primary consumers). The flow of energy then changes as deer may die and pass energy to secondary consumers or decomposers within the natural ecosystem. By comparison, the cattle will be removed from the pasture ecosystem to be consumed elsewhere by humans. Energy in the cattle initially comes from the ecosystem but is not passed to other consumers or decomposers within it. **(5 marks)**

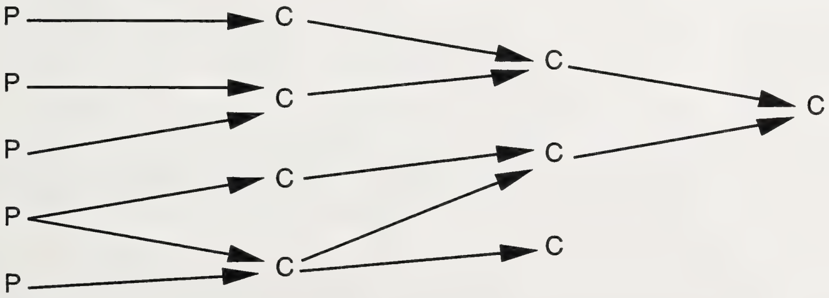
   b. The cycle of matter differs between the natural and human-made ecosystems. Matter will cycle between producers, consumers, and decomposers in the natural ecosystem. Very little matter will leave the ecosystem unless the deer are killed and removed, for example, by hunters. Matter will not cycle in the domestic pasture ecosystem as long as cattle are constantly being removed for human consumption. Eventually matter may have to be added to this ecosystem as fertilizer so the soil can continue to support producers. **(5 marks)**

2. Autotrophs are able to use solar energy directly and convert it to stored chemical energy by photosynthesis. Heterotrophs cannot do this and must rely on feeding behaviours to meet their energy needs. Heterotrophs must consume autotrophs or other heterotrophs. Energy is transferred from autotrophs to heterotrophs. Each transfer of energy creates a separate trophic level. Trophic levels will begin with autotrophs (producers) and progress through any number of heterotrophs (consumers). **(10 marks)**

3. a. Energy will enter the grazer food chain by being captured by a producer such as grass. Then the energy will be passed to a first order consumer, a herbivore, such as a deer. Next the energy will be passed to a second order consumer, a carnivore, such as a wolf. **(5 marks)**

   b. In a decomposer food chain, energy is passed from dead organic matter to decomposers. The dead organic matter comes from dead plants and animals. The decomposers are bacteria and fungi. **(5 marks)**

4. Food webs are formed when matter and energy cross over between different food chains. This occurs when consumers feed on several different kinds of producers and on other consumers. Food webs may contain many different organisms at each trophic level. The trophic levels are connected in numerous places. Food webs begin when consumers eat different kinds of food.



Note: Arrows between P C C may form any branching pattern. Also the numbers of P and C can vary but there should be several of each. Suggest five marks for the diagram, five for the explanation. **(10 marks)**

5. Mercury is a heavy metal toxin which can enter food chains in small amounts from natural and human processes. The mercury is first taken in by producers such as algae and then passed on to consumers such as invertebrates and small fish. As small fish are eaten by large fish, the mercury accumulates by biological amplification and increases in concentration. Eventually the large fish, with high levels of mercury, may be eaten by humans. **(10 marks)**

Section 2: Human Impact

The emphasis in this section is on the quantitative aspect of energy flow through ecosystems and how humans affect the balance that exists within natural ecosystems. The human impact on ecosystems is examined with respect to monocultures, wetland preservation, and the environmental impact of pulp mill development on the Athabasca River Basin.

Section 2: Assignment Answer Key (50 marks)

1. a. Every time energy is transferred from one trophic level to another in an ecosystem, some energy is lost as heat. Energy is lost through respiration and elimination of wastes. **(4 marks)**

   b. This illustrates the Second Law of Thermodynamics. **(3 marks)**

   c. This process creates an energy pyramid. **(3 marks)**

2. Only the pyramid of energy flow will always take the form of a pyramid. More energy will flow into the producer level than into the primary consumer level. Likewise, more energy will flow into the primary consumer level than into the secondary consumer level. Between each level, some energy is lost, leaving less and less energy to be passed on.

   No new chemical energy is added to any food chain after the producer level, and as each trophic level loses some energy as heat, the total amount of energy remaining in the system becomes less and less. The decreasing amount of energy forms a pyramid of trophic levels. **(10 marks)**

3. A modern pulp and paper mill is a large industrial development. Consumption of water, power, and forest resources will increase. Ecosystems will be disrupted as trees are harvested and river water is used. Aquatic ecosystems will be disrupted as water temperatures increase and organic and inorganic substances are released as effluents.

   A positive economic impact may occur when the pulp and paper mill increases jobs in the town. A negative impact may occur if recreational opportunities are reduced due to tree harvest and water pollution. The quality of fishing and hunting may be reduced. Social conflicts may arise as people dependent on the pulp and paper mill for jobs oppose people dependent on undisturbed natural resources for their livelihood.

   Note: The student should discuss ecological, economic, and social issues. Examples of pros and cons may differ, but all three areas must be included. Do **not** judge the answer by the student's own position on development. **(10 marks)**

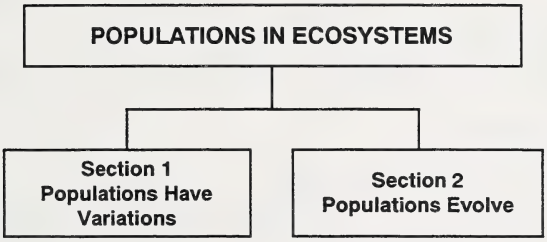
4. Canadian wetlands provide water resources for wildlife and human activities. Wetlands have a large number of different habitats which can support many different kinds of plant and animal communities. They create opportunities for biological diversity and ecological stability. Water in wetlands can help maintain water tables and stabilize water resources between times of flood and drought. Plant life in wetlands can help purify water by removing toxic contaminants. Wetlands provide recreational opportunities and support tourism. This is an economic and social benefit. Wetlands also provide dependable water resources for livestock and irrigation, thus supporting agricultural industry. **(10 marks)**

5. During plant growth, nutrients are captured from an increasing area around the plant. If the number of plants in a given area increases, there may be competition between the plants for nearby nutrients, light, and water. As plant density increases in corn, less nutrients are available for each plant for growth and for storage in cobs. So as plant density increases, the cobs get smaller. **(10 marks)**

Module 4: Populations in Ecosystems

Overview

This module first defines and describes populations and then explains mechanisms of short term and long term changes (evolution). Because long-term changes are not directly measurable and therefore inferential, it is necessary to explain the nature of scientific knowledge in this module. The development of scientific thought on evolution is documented. The major concept that populations are the basic components of ecosystems should be linked to the previous modules as a progression from the biosphere to ecosystems to populations. The process to be kept in mind is the assimilation of matter and energy in living things.


POPULATIONS IN ECOSYSTEMS
Section 1 Populations Have Variations
Section 2 Populations Evolve

Evaluation

The evaluation of this module will be based on two assignments:

Section 1 Assignment	**45 marks**
Section 2 Assignment	**55 marks**
TOTAL	**100 marks**

Materials and Equipment

The following is a list of materials and equipment necessary for a student to complete the activities and investigations in Module 4.

Section 1: Activity 2

- aluminum sulfate (alum)
- small metric ruler
- hand lens
- plastic wrap
- 1.2 kg potting soil
- 4 Styrofoam cups
- 20 Type B wheat seeds (Cutler)
- 20 Type A wheat seeds (Katepwa)
- paper towel
- 2 petri dishes
- tweezers

Aluminum sulfate is available from most greenhouse and garden supply outlets. Only one-quarter teaspoon of aluminum sulfate is added to each student kit, so adjust any laboratory requirement accordingly. Normally, about two weeks are required to complete this investigation. The time may be shortened by combining Part A and Part B concurrently.

This is done by planting the two kinds of wheat in normal soil as a control and the two kinds of wheat in alum-treated soil as a test at the same time. Remember to germinate sufficient seeds.

Wheat seed is available from agricultural seed suppliers such as UGG. Purchase the highest possible pedigree such as registered or certified number one. Purchase untreated seed.

Additional Resources

Alberta Education. 1992. *Senior High Science Teacher Resource Manual.* Edmonton: Department of Education, Curriculum Branch.

Levine, Joseph F. and Miller. 1991. *Biology: Discovering Life.* Lexington, Massachusetts: D.C. Heath and Company.

Vanstone, D. E., Ronald, W. G., and Marshall, H. H. *Nursery Propagation of Woody and Herbaceous Perennials for the Prairie Provinces.* Publication number 1733E available from Communications Branch, Agriculture Canada, Ottawa K1A 0C7

Media Resources

The following are mandatory videos for Module 4:

- *Aspects of Ecology: Populations*
- *Organic Evolution: In the Beginning*
- *Organic Evolution: Darwin, Naturally*

The following are optional videos for Module 4:

- *Natural Selection, Part 1: Natural Selection and Microevolution*
- *Organic Evolution: Factoring in Mendel*
- *Natural Selection, Gradualism Versus the Punctuated Equilibrium Theory of Evolution*
- *One Voice in the Cosmic Fuge*

Section 1: Populations Have Variations

In this section populations are defined and described. Basic concepts are that populations are of the same species and are part of the biotic community; that each is adapted to a specific niche; and that, even though adaptation implies structural similarity, individuals vary widely in their traits. The concept that environments change and, therefore, so does the distribution of a population's traits is dealt with by limiting the discussion to short-term events. Natural selection is introduced.

Section 1: Assignment Answer Key (45 marks)

1. a. Desert deer have large ears which help them hear approaching predators and also help dissipate body heat during the heat of the day. Extra blood flowing through the ears helps keep them from freezing at night. **(5 marks)**

   b. To reduce their need for water, desert deer move about during the cooler times of the day. They may take in water by eating succulant plants. Desert deer also frequent any available water source, natural or human-made. **(5 marks)**

2. Whitetail bucks are more aggressive than mule deer bucks in pursuing receptive does of either species. Consequently whitetail bucks are more likely to breed a mule deer doe even if a mule deer buck is present. **(5 marks)**

3. a.
   - Case Study question a: The resistant strain in the original population was a natural variation.
   - Case Study question b: Over the three stages of the population, the nonresistant strain becomes less frequent. It is reduced by DDT.
   - Case Study question c: Over the course of evolution the resistant trait is favoured and becomes more frequent. The use of DDT suppresses the nonresistant strain and encourages the resistant strain.
   - Case Study question f: In the early years of DDT use, most populations were nonresistant and were eliminated. Only small numbers of resistant mosquitoes survived. In later years, resistant mosquitoes increased and the spray program had little effect. **(5 marks)**

   b. DDT acts as a selective agent by killing nonresistant mosquitoes while allowing resistant mosquitoes to survive and reproduce. By stopping the use of DDT, the selective agent favouring resistant mosquitoes would be removed. The proportion of resistant mosquitoes would decrease as the proportion of nonresistant mosquitoes increased. **(5 marks)**

4. a. If there was no variation, which means no resistance, then all mosquitoes would die. Similarly if all were resistant, then none would die. Because of variation some die and some live. **(5 marks)**

   b. Natural selection results in more and more DDT-resistant mosquitoes in a population. **(5 marks)**

5. If environmental conditions were reversed, such that tree trunks became light coloured again and lichens began to grow, light-coloured moths would have an advantage over dark moths. The light-coloured population would increase and the dark moths would decrease. **(5 marks)**

6. High numbers of eggs increase the opportunity for natural variation to produce a tapeworm which will infect a new kind of host. Each new generation (egg) may have one tapeworm that is adapted to a new host or to any of a group of hosts (mammals, carnivores). **(5 marks)**

Section 2: Populations Evolve

In this section long-term population changes are discussed in the context of the entire evolution of life on Earth. Paleontological data used as evidence for evolution is presented. The nature of scientific knowledge is discussed in this context. Contributions of various scientists to understanding long-term change are reviewed.

Section 2: Assignment Answer Key (55 marks)

1. The seal and dolphin appendages are homologous. They have similar bone structures and have evolved from a recent common ancestor. The seal, dolphin, and tuna appendages are all analogous because they are used for the same purpose – swimming. **(10 marks)**

2. Students may select any two of these explanations. Others are possible.

    - One simple way is the order or depth of burial. Older fossils are buried deeper. These would be from more ancestral organisms. More recent fossils would lie on top.

    - Another way is with homologous structures that may have evolved from a common ancestor. Similarities in structure, for example numbers of bones or teeth, may indicate phylogeny.

    - Another method is complexity of structure. Older fossils from more ancestral forms are simpler. More recent fossils are more complex. **(10 marks)**

3. Ancestral zebras probably had various colour patterns. Some were plain coloured, likely brown; while others, by natural variation, had patches of colour. Plain-coloured zebras were more frequently bitten by tse-tse flies and infected with Plasmodium parasites. Zebras with patterned colouration escaped. As plain-coloured zebras were weakened by infection, the patterned zebras benefited from their adaptation. Over time, zebras with stronger patterns had a selective advantage. This eventually led to the perfect pattern – stripes. **(10 marks)**

4. The modern view of evolution is based on scientific observations and evidence (fossils). It also includes a plausible method, natural selection. Early beliefs were based on opinions and nonscientific beliefs. They lacked a mechanism. Also the modern view includes the ability for change which is supported by evidence in the fossil record. Earlier beliefs proposed a fixed condition which had no supporting evidence. **(10 marks)**

5. Reproduction guarantees the survival of the species. It also guarantees some degree of variation and increases the chances of offspring being better adapted to their environment and surviving. **(5 marks)**

6. Human-made barriers may split populations of organisms creating two populations that cannot mix. The separate populations will reproduce and natural variation will occur. Over time the two populations will grow to be too different to reproduce even if they did mix. At this point they will be different species. This phenomenon is called reproductive isolation. **(10 marks)**

Module 5: Matter and Energy in Cells

Overview

The emphasis of this module is energy systems within cells. The flow of energy through cells can be traced through photosynthesis, an energy-capturing process, and cellular respiration, an energy-releasing process. The method by which cells actually generate ATP should be developed to the point where the students understand how the energy contained in electrons is used to transport protons which are then used to form ATP. An examination of the building of energy-rich compounds versus the breakdown of these compounds is used in developing the concept of the cyclical movement of matter. It is important to note that students are not responsible for specific molecular details in either photosynthesis or cellular respiration.

MATTER AND ENERGY IN CELLS

Section 1
Sunlight – Beam It Down

Section 2
ATP: The Energy in You

Evaluation

The evaluation of this module will be based on two assignments:

Section 1 Assignment	**50 marks**
Section 2 Assignment	**50 marks**
TOTAL	**100 marks**

Materials and Equipment

The following is a list of materials necessary to complete the investigations and activities in Module 5.

Section 1: Activity 1 – Part A

- filter-paper
- 400 mL beaker or water glass
- scissors
- water
- red and green food colouring
- two toothpicks

Section 1: Activity 1 – Part B

- filter-paper
- scissors
- spoon
- small bowl
- toothpick
- 100 mL methanol
- fresh green plant
- 400 mL beaker
- non-flame heat source

Section 1: Activity 2

See the Laboratory on page 196 of textbook for a complete list of materials needed.

Additional Resources

Campbell, Neil A. 1990. *Biology*. 2nd Edition. Don Mills, Ontario: Benjamin/Cummings.

Mader, Sylvia S. 1990. *Biology*. 3rd Edition. Dubuque, Iowa: Wm. C. Brown Publishers.

Media Resources

The following are optional videos for Module 5:

- *Photosynthesis* (Marlin Motion Pictures)
- *Experiments in Photosynthesis* (ACCESS Network)
- *Cellular Respiration: The Cell and Energy* (ACCESS Network)

Many of the videos listed in Module 5 are segments found on one of the videos from this list. The video *Experiments in Photosynthesis* illustrates many investigations along with optimal results. The ACCESS Network videos *Photosynthesis* and *Cellular Respiration* illustrate these processes with animated sequences. These two videos are broken up into key segments for easier study. They could be used to accompany a lesson sequence or as review. They should not be used for introduction to the topic as too much information is presented at once.

Section 1: Sunlight – Beam It Down

This section deals with four main concepts as outlined in the table of contents. The first activity requires the student to understand plants contain pigments capable of trapping light energy and generating stored chemical energy. The skill of chromatography should be developed. The second activity can be difficult to master. It requires that the student understand that ATP is the energy unit that powers all living activities. Activity 3 requires the understanding that ATP can be generated by photosystems and is then stored as glucose. The use of the videos is highly recommended if the student is to master this subject. The final activity involves a societal question on the use of herbicides. This is extended in the Enrichment and could be expanded further depending on the interest of the students. Another possible activity would be to get the students to interview private landowners regarding their use of herbicides.

Section 1: Assignment Answer Key (50 marks)

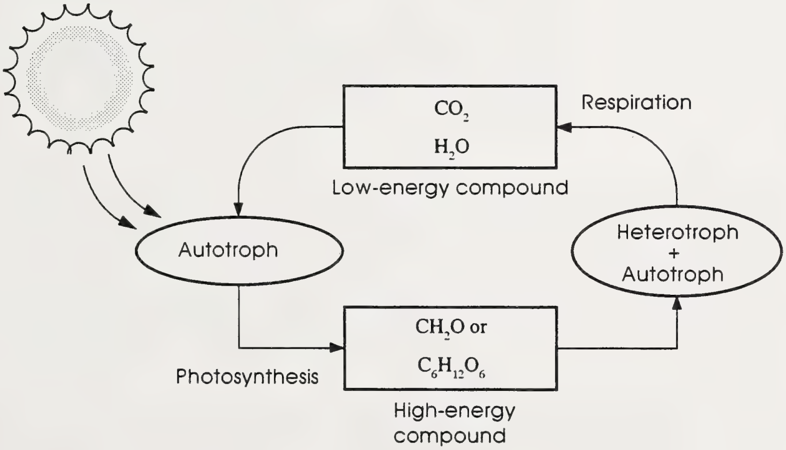
1. Chlorophyll is the substance that gathers the energy that is necessary to sustain the biosphere. If it was not present, most life would not be able to exist. Chlorophyll initiates the reactions that convert solar energy into chemical energy. **(2 marks)**

2. a. From the diagram one can identify at least four separate substances due to the appearance of four bands in different positions on the strip. One should keep in mind that there may be more substances if different compounds travel at the same rate. **(2 marks)**

   b. Chromatography is able to separate substances because as the solvent travels up the strip, those substances that have the greatest solubility are able to move up the paper faster. As the solvent evaporates, the solute comes out of solution and the telltale band appears. **(2 marks)**

3. Green glazing would be inappropriate as a choice for a greenhouse. As demonstrated by Engelmann's experiment and modern spectrophotometric analysis of leaf pigments, green light is the wavelength that plants use the least. As the purpose of the greenhouse is to facilitate plant growth, the choice would in fact be detrimental to the growth of plants as they would not be able to carry on the process of photosynthesis effectively using only green light. A more appropriate glass would be clear to transmit natural sunlight. **(2 marks)**

4. a. **(2 marks)**



   b. Both heterotrophic and autotrophic organisms must carry on cellular respiration to provide their cells with energy. Autotrophic organisms are special in that their method of obtaining these complex organic compounds is to form them by using energy from the sun. Heterotrophic organisms must injest their food in order to meet their energy demands. **(2 marks)**

5. ___e___ an energy storage molecule in living cells

___c___ the movement of protons across a membrane generating ATP

___d___ energy required to initiate a chemical reaction ____b____ a reaction that liberates energy

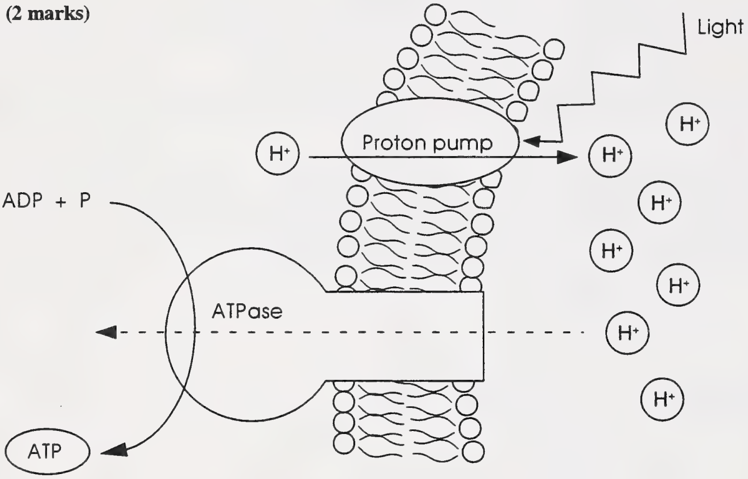
____a____ a reaction that requires energy **(10 marks)**

6. a. ATP holds more energy than ADP. In order to attach the third phosphate molecule to a molecule of ADP, a great deal of energy is required compared to the energy needed to attach the previous phosphate molecule. The energy is stored in the complex interaction of atoms within the molecule that attaches the third phosphate in ATP with a high-energy bond. **(2 marks)**

   b. The energy from ATP is released when the third phosphate group is removed from the molecule and the high-energy bond is broken. **(2 marks)**

   c. Gold coins have more value than silver coins of the same size. Gold is rarer than silver hence its higher value. ATP can be compared analogously to a gold coin because of its greater value to a cell. A molecule of ATP contains more useful energy than a molecule of ADP. ADP is comparable to silver. **(2 marks)**

7. **(2 marks)**

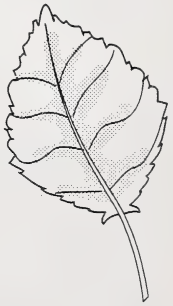


8. ATP can be used for three types of cellular activities. The active transport of essential substances in or out of a cell requires energy. Chemical reactions that build or break down materials (protein synthesis, digestion) are dependent upon ATP to initiate the reaction. Contractile proteins within the cells and especially in muscle cells use ATP to bring the fibres closer together. **(2 marks)**

9. a. Does the absence of light affect a leaf's ability to produce starch if glucose is present? The manipulated variable is the presence of glucose and the responding variable will be the presence or absence of starch. **(2 marks)**

   b. The leaf in the 5% glucose solution will show a positive starch test in spite of being kept in the dark. The leaf would not be able to manufacture glucose via photosynthesis, but because there is glucose available to the cells of the leaf, the glucose would be transported up the stem and be converted into starch. **(2 marks)**

Water

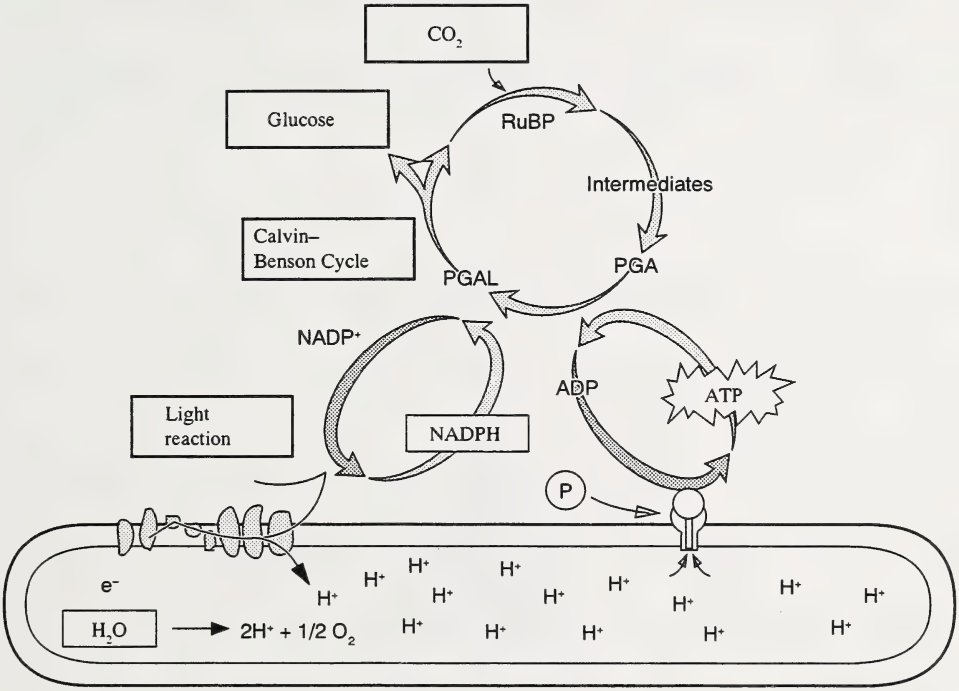


5% glucose

c. Fixed variables are necessary in an experiment to insure that the results obtained are in fact due to the manipulated variable. Any conditions that vary between systems would invalidate the experiment. Possible fixed variables are temperature, age of leaf, amount of carbon dioxide, volume of liquid, time, and darkness. **(2 marks)**

10. Solar cells are able to generate electricity because the electrons that are energized by the light are moved to another area creating an imbalance. They are allowed to return to the original area through a conductor. Chlorophyll also uses solar-energized electrons in a system to transform the sun's energy into a useful form. Energized electrons are pumped across a membrane and can return to the chlorophyll molecule or be passed on through the electron transport system. **(2 marks)**

11.



(2 marks)

12. CO_2 that is absorbed by plants is incorporated into larger carbohydrate molecules eventually resulting in glucose. This glucose can then be used as a base molecule for carbohydrates such as starch or cellulose. The water that is used in photosynthesis is separated into protons, electrons, and oxygen. The oxygen is liberated, the electrons replace those that were removed from the chlorophyll molecule, and the protons stay in the thylakoid space to maintain the concentration gradient. Eventually the protons will be transferred to the Calvin-Benson cycle by $NADP^+$ as NADPH and finally end up in the carbohydrate that is produced. **(2 marks)**

13. The ATP that is generated in the light reaction provides the energy for the formation of carbohydrate molecules in the Calvin-Benson cycle. Without this energy these reactions could not take place. **(2 marks)**

14. As the electrons are transferred down a chain of electron acceptors, energy is removed and transferred to ATP. **(2 marks)**

15. If a herbicide blocked the production of Substance Q, then no Q would be available to react with R and form S, which is a part of chlorophyll. Without chlorophyll the plant would die. **(2 marks)**

Section 2: ATP: The Energy in You

This section deals with the production of ATP from carbohydrates and how this energy is required for athletes and how production of it can be halted by toxins. Activity one introduces the complexities of ATP production. Students should develop a basic understanding of the processes of cellular respiration. Do not dwell on the details of glycolysis or the Krebs cycle; simply get them to understand what is required to initiate the reactions and what the products are. Activities 2, 3, and the Enrichment are written to help you develop in the student an appreciation of metabolic toxins, athletic training strategies, and the use of methane as an energy source. Further information on the effects of cyanide and performance-enhancing drugs on cellular respiration could also be explored by the students.

Section 2: Assignment Answer Key (50 marks)

1. The electron transport system transfers hydrogen atoms and electrons to oxygen to form water. If the system were blocked, the hydrogen atoms and electrons would accumulate and disrupt body pH. Secondly, no ATP would be produced and the body would run out of energy. **(4 marks)**

2. a.

$$\begin{array}{r} 100\text{ mL} \\ -\ 40\text{ mL} \\ \hline 60\text{ mL} \end{array}$$

60 mL/20 g/2h = 3 mL/g/2h = 1.5 mL/g/h **(2 marks)**

b. The flask was set up as a fixed or controlled variable. A temperature or pressure change would cause the reading in the manometer to change; therefore the establishment of a control allows for these variables to be monitored. **(2 marks)**

c. The KOH must be present to absorb carbon dioxide. In cellular respiration the amount of carbon dioxide produced equals the volume of oxygen consumed.

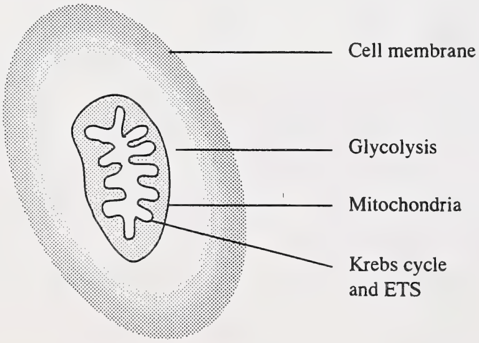
$C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$

If the KOH were not present, there would be no change in the volume as the CO_2 would balance the O_2. **(2 marks)**

3. a. The reaction shown is anaerobic respiration. This reaction takes place in muscle cells under low oxygen conditions. The muscle cells must produce energy in order for the organism to continue the activity. With insufficient oxygen the cells produce lactic acid instead of CO_2 and H_2O. **(2 marks)**

b. Athletic training increases your body's ability to deliver oxygen to your muscle cells. If more oxygen is available during an activity, it will delay fatigue of the muscle thereby increasing performance. **(2 marks)**

4. **(6 marks)**



5. Oxygen is the final electron acceptor in the electron transport system. When the oxygen combines with electrons, protons are also attached and a water molecule is formed. If oxygen is not present, the oxidation-reduction reactions in the electron transport system cannot take place and ATP production will not continue. **(2 marks)**

6. a. substance oxidized —— (e^-) → substance reduced **(2 marks)**

b. When an NAD^+ attracts an electron, it will also attract protons (hydrogen ions). **(2 marks)**

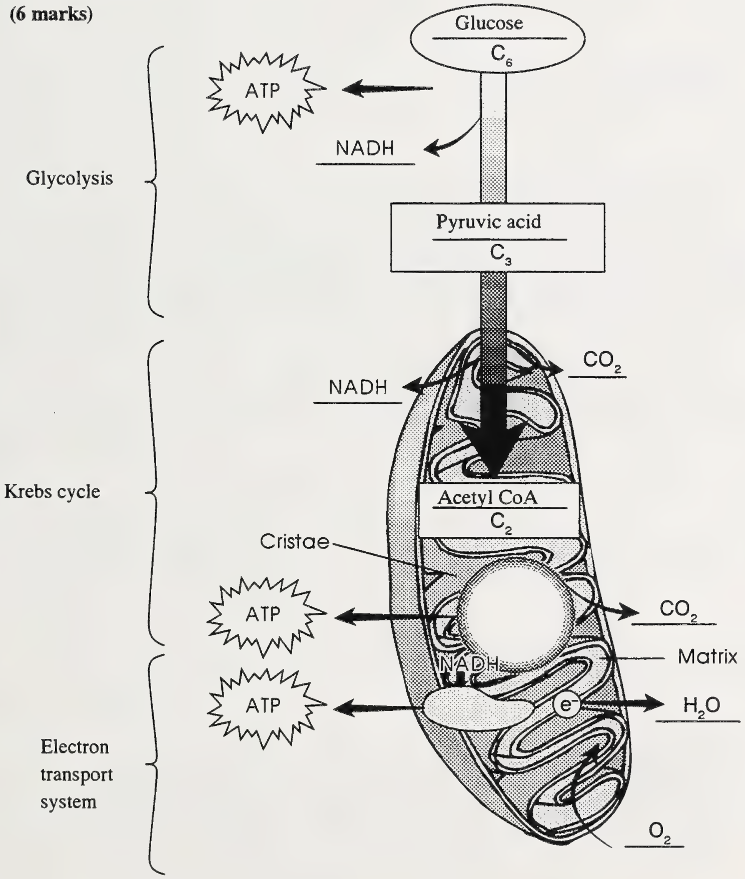
7. a. The reaction occurs at the beginning of respiration to energize the glucose molecule. In other words, the glucose has been supplied with activation energy. **(2 marks)**

   b. The name of the reaction is phosphorylation. **(2 marks)**

8. The maximum amount of ATP will be produced in test tube X. Not only do the cells have a supply of glucose for energy, but because the test tube is open to the atmosphere, oxygen is readily available. If oxygen is not present, aerobic respiration, which produces almost twenty times more ATP, could not occur. **(4 marks)**

9. The process illustrated is called chemiosmosis. This is how ATP is generated in an electron transport system. When an electron transport chain extracts the energy in electrons via a series of oxidation-reduction reactions, protons are pumped across a membrane concentrating them on one side. As these protons diffuse back across the membrane, ATP is produced. **(4 marks)**

10. **(6 marks)**



11.

	AEROBIC	ANAEROBIC
Reactants	glucose + oxygen	glucose
Products	$CO_2 + H_2O$	lactic acid
ATP	36	2

or

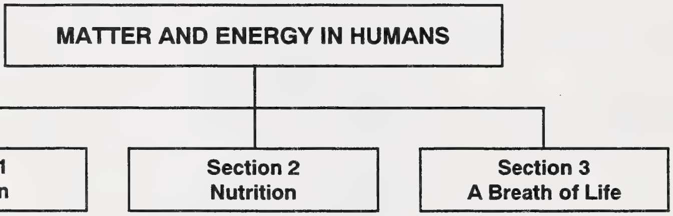
	REACTANTS	PRODUCTS	ATP
Aerobic	glucose + oxygen	$CO_2 + H_2O$	36
Anaerobic	glucose	lactic acid	2

(6 marks)

Module 6: Matter and Energy in Humans

Overview

The emphasis of Module 6 is on organ systems that support the exchange of matter and energy with the environment. The digestive and respiratory systems are studied from a structure and function perspective. Nutrition is studied through simple tests for the presence of fats, proteins, and carbohydrates. An appreciation for responsible decision making regarding a healthy lifestyle is begun in Module 6 and continued into Module 7. Ethical decisions regarding health care and organ donation is introduced along with examples of the possible contributions of science and technology. While learning about their own organ systems, students should be reminded of the importance of decisions that affect their personal health and the quality of life.



Evaluation

The evaluation of this module will be based on three assignments:

Section 1 Assignment	**40 marks**
Section 2 Assignment	**25 marks**
Section 3 Assignment	**35 marks**
TOTAL	**100 marks**

Materials and Equipment

The following is a list of materials and equipment necessary for an individual to complete the investigations and activities in Module 6. Adjust the amount of equipment if more than one individual is involved.

Section 1: Activity 2

- package of gelatin
- 5 mL meat tenderizer
- three petri dishes
- hot water
- 1 mL measuring spoon
- refrigerator

See page 237 of the textbook for the materials for the lab on enzymes and pH in Activity 2.

Section 2: Activity 1

See page 163 of the textbook for the materials for the investigation.

Section 2: Activity 2

See page 171 of the textbook for the materials for the investigation.

Section 3: Activity 4

Posture/brochure: *Organ & Tissue Donation* from Human Organ Procurement and Exchange program. University of Alberta Hospitals in Edmonton and Foothills Hospital in Calgary. These postures are available in class set numbers.

Additional Resources

Alberta Education. 1992. *Senior High Science Teacher Resource Manual.* Edmonton, Alberta: Department of Education, Curriculum Branch.

Berry, Gordon S. and Gopaul, Harold S. 1982. *Biology of Ourselves.* Toronto, Ontario: John Wiley and Sons.

Galbraith, Don. 1992. *Biology Directions.* Toronto, Ontario: John Wiley and Sons.

Kormondy, Edward J. and Essenfeld, Bernice E. 1984. *Biology.* Menlo Park, California: Addison-Wesley Publishing Company.

Levine, Joseph S. and Miller, Kenneth R. 1991. *Biology.* Lexington, Massachusetts: D.C. Heath and Company.

Media Resources

The following are mandatory videos for Module 6:

- *Human Body: Digestive System*
- *Healthy Choices, Healthy Hearts*

The following are optional videos for Module 6:

- *Organic Chemistry: Harvest of Enzymes*
- *Have You Considered Organ Donation?*

Section 1: Digestion

This section describes the intake of food from the environment, its processing through the digestive system, and the return of the remaining material to the environment. Students will be able to accurately identify the structures that make up the digestive system and describe their functions. Students will also investigate the influence of enzyme concentration, temperature, and pH on the activity of enzymes, especially those involved in digestion. This section is designed to emphasize the exchange of matter and energy through the digestive system.

Teaching Suggestions

The best way to describe the digestive system is to actually show one to your students. Be aware of any health restrictions before bringing fresh specimens into your classroom. Preserved specimens such as a rat are good. The second best example is a manufactured replica which is available in some schools. Media resources are also recommended. Enzymes such as pepsin, lipase, and bile can be purchased and used to demonstrate the chemical breakdown of nutrients. The results may not always be too obvious to the students, but the activity is worthwhile. Look for subtle changes. Keep relating the concept of good nutrition to the actual process of digestion. This will help students to understand why disorders do sometimes occur and that these disorders may be linked to poor dietary habits.

Section 1: Assignment Answer Key (40 marks)

1. a. small intestine
   b. stomach
   c. mouth
   d. gallbladder
   e. liver
   f. pancreas
   g. large intestine
   h. stomach or small intestine
   i. mouth
   j. large intestine **(10 marks)**

2. Design B is better because of the wider range of pH. This would indicate a general pH that could be tested further. Design A could be used after Design B to test a specific pH if some digestion initially occurred between pH 2 and pH 5. **(5 marks)**

3. Normally digestion of the stomach does not occur because the cells are protected by a layer of mucus. **(5 marks)**

4. Pepsinogen must be activated by hydrochloric acid (HCl) and converted to pepsin before it can actively digest proteins. **(5 marks)**

5. Bile behaves like a detergent when it breaks down fats. Bile functions in the duodenum after stomach acids have been neutralized by sodium bicarbonate and pH has increased into a basic range (8.0 – 9.0). **(5 marks)**

6. The enzyme amylase in saliva breaks down starch in the cracker or potato chip into sugar. Starch is relatively tasteless especially compared to sugar. **(5 marks)**

7. a. Test tube 1 would show no digestion because the enzyme needs HCl. Test tube 3 would show no digestion because HCl is needed and NaOH would create a basic pH. Test tubes 4, 5, and 6 would show no digestion because the enzyme would be destroyed by heat.

   b. Test tube 2 would show the most digestion because HCl would activate pepsinogen.

   c. Sodium hydroxide would not activate pepsinogen and would further neutralize HCl. **(5 marks)**

Section 2: Nutrition

This section allows students the opportunity to study the complexity of food. Included are activities that enable students to do the following:

- identify essential nutrients
- discuss the role of additives
- investigate food preservation processes like irradiation
- discuss nutritional deficiencies and their effects on homeostasis

It is vital that all lab activities be tried first by the learning facilitator prior to presentation to students.

Section 2: Assignment Answer Key (25 marks)

1. Lipids act as carriers moving vitamins into cells. Without lipids, vitamins may not enter cells and cause symptoms of vitamin deficiency. **(5 marks)**

2. a. Test compound X with amylase to determine if it will dissolve in the mouth. Test compound X with HCl and pepsin to determine if it will dissolve in the stomach. Test compound X with bile salts and pancreatic enzymes such as lipase to determine if it will dissolve in the intestine. **(5 marks)**

b. The best substance for compound X would be a lipid. **(5 marks)**

3. The test tubes are not labelled a or b in the module. It is to be assumed that students will accept the first test tube as a, and the second as b. **(10 marks)**

TEST TUBE	BENEDICT'S	BIURET	IODINE
a	–	–	+
b	+	+	–

Section 3: A Breath of Life

This section describes how gases and heat are exchanged between the body and the atmosphere. The mechanics of breathing are stressed while students study the principle features of the respiratory system.

The effects of smoking are assessed.

Students are also asked to compare and contrast the societal definition of death to the scientific definition. The implications of organ transplants are evaluated through an extensive examination of materials from the Human Organ Procurement and Exchange program (H.O.P.E.).

Extensive materials are available from H.O.P.E. and from the Kidney Foundation of Canada, Edmonton and Northern Alberta Chapter. Some class sets may be available. The Kidney Foundation has an excellent video on organ donation for use with high school students. Addresses for these agencies are provided in the section.

Teaching Suggestions

Smoking is a good topic to stimulate discussion. Students can find that they are in difficult situations when they are learning about the biological effects of smoking. They often have parents and relatives who smoke around them. It is important to be sensitive to their discussions.

Talking about death is a sensitive topic. Some students have little knowledge about it. It is important to give students accurate information at all times. A guest speaker on the topic would greatly add to the dimension of learning.

Studying the respiratory system can be very interesting. Try to show actual structures to students. Beef lungs and trachea may be obtained from meat-packing plants. Actual specimens help students apply the knowledge. Audiovisual media is recommended.

Representatives from health clinics or agencies concerned with cardiovascular and respiratory health are good resources. Organ donation is a serious topic and deserves careful approach. Contacting H.O.P.E. and the Kidney Foundation of Canada before starting this section is suggested. As an opener, consider showing students the donor card on a driver's licence.

Section 3: Assignment Answer Key (35 marks)

1. Expiration occurs when the diaphragm rises in the chest cavity. This reduces the volume and increases the pressure in the chest cavity relative to the atmosphere outside. Air is forced out by the higher pressure inside the lungs. **(10 marks)**

2. First, normal atmospheric pressure is required to force air into the lungs during inspiration. If atmospheric pressure is very low, very little air will enter the lungs. Second, a low pressure environment will have low density, that is, fewer molecules of oxygen in a given volume. Diffusion of oxygen into the blood would be reduced because fewer molecules would enter the lungs. **(10 marks)**

3.

COMPONENTS	EXHALED AIR
Oxygen	Lower
Carbon dioxide	Higher
Nitrogen	Unchanged
Water vapour	Higher
Heat	Higher

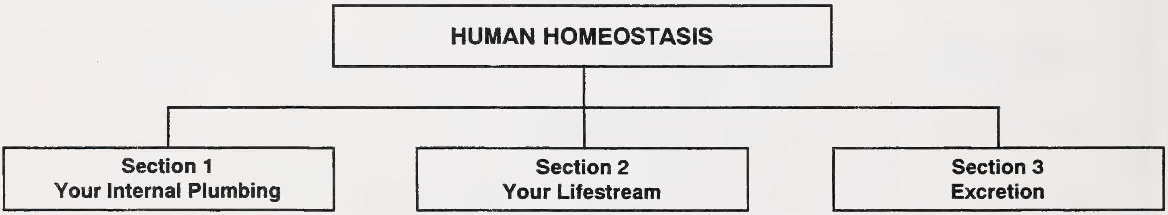
Students may compare inhaled to exhaled air but the question only asks for a description of exhaled air. They should not be penalized for a more complete answer. **(10 marks)**

4. In the case of emphysema, the inner surface of the alveolus has been eroded. This would reduce the surface area available for the diffusion of oxygen into the blood and lower the efficiency of oxygenation. While a slightly larger volume of air may enter the alveolus, fewer molecules of oxygen would actually contact the inner membrane surface and diffuse into blood capillaries. **(5 marks)**

Module 7: Human Homeostasis

Overview

This module explores the challenges confronting the circulatory and excretory systems in maintaining internal homeostasis. Students participate in activities which demonstrate the interplay of these systems with other body systems to achieve this inner balance. The basic structure and function of organs comprising the circulatory and excretory system are examined. A fieldtrip to a Blood Donor Clinic and a visitation to a Dialysis unit at a hospital would be excellent activities to incorporate into this module. Guest speakers could also be invited to make a classroom presentation.



Evaluation

The evaluation of this module will be based on three assignments:

Section 1 Assignment	**30 marks**
Section 2 Assignment	**30 marks**
Section 3 Assignment	**40 marks**
TOTAL	**100 marks**

Materials and Equipment

The following is a list of materials and equipment necessary for an individual to complete the investigations and activities in Module 7.

Section 1: Activity 2

- liquid crystal strip thermometer
- instruction guide
- elastic strip
- access to a mirror

Section 1: Activity 3

- access to stairway
- watch or clock with second hand
- calculator

Section 2: Activity 1

- microslide viewer
- microslides – set 95, Human Blood

Section 3: Activity 2

- colour chart
- four Multistix
- 10 mL graduated cylinder
- masking or label tape
- small glass or beaker
- distilled water
- four small test tubes
- four simulated urine samples W– protein, pH 8.0, S.G. 1.000
  - X – glucose
  - Y – ketone
  - Z – normal

Resources

Pamphlets and other written information can be obtained from the following sources. Some of these sources also have videos which can be borrowed for group presentations.

- The Heart and Stroke Foundation of Alberta and The Kidney Foundation of Canada (Edmonton and Northern Alberta Chapter) can be contacted for pamphlets and videos.

  Heart and Stroke Foundation of Alberta
  10985-124 St.
  Edmonton, AB. T5M 0H9
  ph. 451-4545 Fax: (403) 454-1593

  (Local offices are also located in Lethbridge, Medicine Hat, and Red Deer)

  The Calgary office has an education coordinator who would be willing to assist in classroom presentations in that area.

  Contact:
  Heart and Stroke Foundation of Alberta
  Att. Ms. Emily Alstad
  Education Coordinator
  1825 Park Road S.E.
  Calgary, AB. T2G 3Y6
  ph. 264-5549 Fax: (403) 237-0803

- Canadian Red Cross Society
  The Canadian Red Cross would be an excellent contact for supplementary information on the blood donor program for print resources and guest speakers on the blood donor program).

  Att. Ms. Terry Van Den Dussche
  Canadian Red Cross Society
  Coordinator International Society
  Coordinator International Services
  9931-106 St. Edmonton, AB. T5K 1E2
  ph. 423-2680 Fax: (403) 428-7092

- The Kidney Foundation of Canada can be contacted for print resources and guest speakers on dialysis or the H.O.P.E. (Human Organ Procurement and Exchange) program.

  The Kidney Foundation of Canada
  Att. Judy L. Carwell
  Executive Director
  Edmonton and Northern Alberta Chapter
  11574-149 St.
  Edmonton, AB T5M 1W7

- Burn Unit – University of Alberta Hospital can be contacted for print resources only.

  Contact:
  Ms. Thelma Inkson, R.N.
  Nurse Manager
  The Firefighter's Burn Treatment Unit
  4C2.00 WMHSC
  8440-112 St. Edmonton, AB.
  ph 492-8245

Additional Resources

Galbraithe, D. 1993. *Biology Directions*. Toronto, Ontario: John Wiley and Sons Ltd.

Kormondy, E.J. and Essenfeld, B.E. 1984. *Biology*. Teacher's Edition. Don Mills, Ontario: Addison-Wesley Publishing Company.

Levine, Joseph S. and Miller, Kenneth R. 1991. *Biology*. Lexington, Massachusetts: D.C. Heath and Company.

Ritter, R., Drysdale, B., and Coombs, D. 1987. *Biology: A Canadian Laboratory Manual*. Agincourt, Ontario: GLC Silver Burdett Publishers Limited.
See labs 50 and 51.

Ritter, R. and Samiroden, W. 1993. *Biology Teacher's Resource*. Scarborough Ontario: Nelson Canada.
This is the teacher's resource book for the *Nelson Biology* textbook.

Media Resources

The following are mandatory videos for Module 7:

- *Healthy Choices, Healthy Hearts*
- *The Immune System: Your Magic Doctor*

The following is an optional video for Module 7:

- *Homeostasis: Osmoregulation*
- *Respiratory and Circulatory System*

Section 1: Your Internal Plumbing

This section investigates the structure of the heart and blood vessels emphasizing their role in maintaining homeostasis. Students manipulate variables which demonstrate changes in peripheral circulation and pulse rate. The interaction of the circulatory system with other body systems is explored. Lifestyle and its relationship to blood pressure and heart disease is examined. The Heart and Stroke Foundation of Alberta should be contacted as an additional resource for videos and pamphlets to enhance this section.

Section 1: Assignment Answer Key (30 marks)

1. The digestive system acquires matter and energy as nutrients and breaks them down to simple components. These are absorbed by the circulatory system and delivered to cells. The circulatory system also delivers oxygen from the lungs. The nutrients are metabolized with oxygen to provide energy for cell processes. This produces heat and waste products which go back into the circulatory system. As a waste product, CO_2 is delivered to the lungs. Other soluble wastes are delivered to the liver and then to the kidneys for excretion. Heat is distributed throughout the body and maintains body temperature. Students may also mention the disposal of wastes in the digestive system and the dissipation of excess heat through the lungs and peripheral circulation. **(10 marks)**

2. Once skin sensors receive the message that the external environment is cold, the arterioles in the peripheral circulation constrict. This restricts blood flow to the extremities and allows the warm blood to remain in the body core. This homeostatic response is necessary to prevent heat loss from the body core. The peripheral regions of the body (e.g., fingers and toes) are sacrificed in order to maintain body core temperatures. **(5 marks)**

3. In the digestive system the drug will be absorbed by the villi of the small intestine into the bloodstream. Some absorption may also occur through the stomach wall. The circulatory system then takes over. The bloodstream carries the drug through the liver to the heart via the vena cava. It will move to the lungs and will return to the left atrium which leads to the left ventricle. With the contraction of the left ventricle, the drug will be transported from the aorta into the carotid artery up to the head. The carotid branches into smaller arterioles leading to the capillaries. The capillaries of the skin will then deliver the blood to where the drug can diffuse into the skin cells to do its work. **(5 marks)**

4. With the contraction of the left ventricle, blood would leak back into the left atrium. The volume of oxygenated blood leaving from the left ventricle (cardiac output) would be reduced. As the child became more active they would become fatigued as their muscle cells would be receiving insufficient oxygen and nutrients. There would also be an increased strain on the child's heart as heart rate would increase in response to the increased blood carbon dioxide levels. **(2 marks)**

5. Subject B does not exercise regularly. This person had the slowest recovery rate from the 10 minute exercise and a higher resting heart rate. Slow recovery time after strenuous exercise and a higher resting heart rate are both indicators of a lack of fitness. **(3 marks)**

6. Accept any three of the following:

    - Increase physical activity: Regular exercise will strengthen the heart and help to reduce body mass. The heart will become more efficient, beating less, and lowering blood pressure.

    - Reduce stress: Stress increases blood pressure by increasing the heart rate and causes constriction of major arteries. Reducing emotional stress should contribute to lowering blood pressure.

    - Stop smoking: Chemicals (nicotine, etc.) in cigarette smoke cause blood vessels to constrict and increases heart rate which increases blood pressure.

    - Reduce fat/cholesterol intake: Fatty foods can contribute to plaque forming cholesterol which narrows major arteries thereby increasing blood pressure. A diet low in fats will diminish this effect.

    - Lose weight: Excess body mass causes the heart to work harder and increases blood pressure.

    - Reduce salt intake: A high-salt diet increases blood fluid volume which increases blood pressure. Reducing salt intake will help reduce blood pressure. **(5 marks)**

Section 2: Your Lifestream

This section examines the role of blood in maintaining health. Blood components are identified and discussed in the first activity. The second activity stresses the immune response and discusses immunization. In the third activity a case study approach is used to determine the impact of a severe burn on the circulatory system. The Firefighters' Burn Treatment Unit at the University of Alberta can be contacted for print resources.

Section 2: Assignment Answer Key (30 marks)

1. a. Red blood cells transport respiratory gases – oxygen and carbon dioxide. **(1 mark)**

   b. White blood cells are the main components of the body's immune system. They defend the body against invading pathogens. **(1 mark)**

   c. Platelets contain proteins that initiate and control blood clotting. **(1 mark)**

2. a. White blood cells lack hemoglobin and contain a nucleus; whereas red blood cells contain hemoglobin and lack a nucleus. **(2 marks)**

   b. White blood cells are able to reproduce inside the circulatory system because they contain a nucleus. **(2 marks)**

3. a. Individual C most likely lives at a high altitude indicated by a high hemoglobin count. Hemoglobin is related to the red blood cell (RBC) count. As the oxygen concentration decreases, the red blood cell count increases. With increased altitude, one would expect a higher RBC count and therefore a higher hemoglobin concentration. **(2 marks)**

   b. Individual B has an increased white blood cell (WBC) count which would indicate that this individual is fighting an infection. The WBC production increases in response to bacteria multiplying in the body. **(2 marks)**

4. Lymph is the clear liquid which is lost through the capillary walls of the circulatory system and picked up by the vessels of the lymphatic system. White blood cells carried in the lymph attack foreign particles such as bacteria in the tissues. **(2 marks)**

5. Vaccines contain harmless (non-virulent) strains of a specific pathogen or disease organism. An injection of the vaccine triggers an immune response against the pathogen. The body produces antibodies which provide protection against the real disease organisms. **(3 marks)**

6. The HIV virus is able to penetrate cells of the immune system itself (Helper T cells). Because these cells are killed, the immune response is impaired. **(2 marks)**

7. If the tissue has been severely burned, it releases chemicals called histamines which make the walls of the capillaries leaky to plasma proteins. This creates a concentration gradient in which water moves by osmosis out of the bloodstream into the surrounding tissue. This results in tissue swelling or edema. **(4 marks)**

8. The skin is the first line of defence against pathogenic invaders. If the outer skin is burned away, the body becomes vulnerable to bacterial infection. **(2 marks)**

9. Phagocytosis is the process of engulfing particles by surrounding them to create a food vacuole. In the immune response, macrophages engulf invading pathogenic organisms by this process. **(2 marks)**

10. Antibodies are specific proteins that bind to specific pathogens. Lymphocytes (B cells) produce the antibodies. **(2 marks)**

11. A person with anemia would feel tired and lacking of energy. This is a result of the lack of red blood cells or hemoglobin which reduces their ability to transport oxygen to their body cells. **(2 marks)**

Section 3: Excretion

This section explores the role of the kidneys in maintaining homeostasis. The close association between the circulatory system and kidney function is stressed. Kidney diseases are diagnosed through an investigative approach and the effect of lifestyle on maintaining healthy kidney function is discussed. The role of technology for patients undergoing dialysis is explained. For additional information contact the Kidney Foundation of Canada, Edmonton and Northern Alberta Chapter.

Information and possible assistance in urinalysis technology can be requested from Miles Canada Inc. Write to

Diagnostics Division
Miles Canada Inc.
140-3751-Shell Road
Richmond, B.C. V6X 2W2
1-800-663-0921

Synthetic urine can be obtained from supply companies such as Carolina Biological, Boreal Laboratories, and Northwest Laboratories. Medical clinics and hospitals sometimes have urine test strips that are out of date but would be great for use in student labs.

Section 3: Assignment Answer Key (40 marks)

1. a. Blood cells and plasma proteins are retained in the bloodstream as they are too large to pass through the glomerulus into Bowman's capsule. **(2 marks)**

   b. Nutrient molecules such as glucose and ions such as sodium are reabsorbed into the bloodstream by the nephron. **(2 marks)**

   c. ADH secretion by the pituitary gland increases the reabsorption of water into the bloodstream by making the nephron more permeable to water. **(2 marks)**

2. The kidney plays a critical role in ensuring that the composition of the blood remains in a steady state. Examples could include two of the following:

   water – Dehydration causes ADH secretion. ADH makes the nephron more permeable to water. This increases water reabsorption into the bloodstream.

   ions – Sodium and other ions such as hydrogen are reabsorbed into the bloodstream or secreted depending on the needs of the body.

   urea – Urea diffuses and is actively transported from the bloodstream into the nephron to ensure excretion in the urine. **(4 marks)**

3. a. Subject B possibly has diabetes mellitus as there is evidence of glucose in the urine as well as a higher urine output. **(2 marks)**

   b. Subject D has low ADH secretion indicated by a high urine output. **(2 marks)**

   c. Subject C would be diagnosed as having capsular failure indicated by protein in the urine. **(2 marks)**

4. Blood/water content is monitored by specialized cells in the hypothalamus that are sensitive to osmotic pressure. As the blood water level decreases (dehydration), these cells stimulate the pituitary gland to release ADH. This hormone increases the permeability of certain sections of the nephron to water. This increases the reabsorption of water into the bloodstream. Students may compose a simpler answer. When blood/water content increases, kidneys release water. When blood/water content is too low, kidneys reabsorb water. **(2 marks)**

5. a. iii **(1 mark)** d. ii **(1 mark)** c. i **(1 mark)** b. iv **(1 mark)** e. v **(1 mark)**

6. The dialysis machine contains a thin cellophane barrier which separates a specially balanced dialysis fluid from the individual's bloodstream. Substances move by passive diffusion from the blood across the membrane barrier into the dialysate resulting in the purification of the individual's blood. **(2 marks)**

7. Low blood pressure will result in little or no blood flow into Bowman's capsule. Blood will not be filtered. Wastes will build up. High blood pressure can rupture the glomerulus and the capsule, destroying its filtering capacity. As a result, large blood components would be excreted in the urine. **(2 marks)**

8. a. The student's hypothesis is that the intake of coffee (caffeine) increases urine output. **(2 marks)**

   b. Accept any four of the following. The controls for the experiment should include early-morning testing after going to the bathroom and before eating or drinking, same sex and same age subjects, same coffee brand used for all subjects, same mass of subjects, same health, e.g., no hypertension and same activity level. **(4 marks)**

   c. The subjects drinking the coffee should produce more urine as caffeine stimulates the heart rate thus increasing the volume of blood passing through the glomerulus and reducing ADH secretion. **(2 marks)**

9. Any two of the following are acceptable:

    - The lungs eliminate carbon dioxide and water vapour.
    - The large intestine gets rid of indigestible food and bacterial toxins.
    - The skin eliminates excess water and salt through sweat glands. **(2 marks)**

10. Urea is formed in the liver by deamination. Nitrogen and hydrogen ions (amines) could form toxic ammonia but instead are assembled into less toxic urea. Urea is continually secreted into the nephron from the bloodstream by diffusion and active transport. The kidneys filter the urea out of the blood and excrete it. **(3 marks)**

CHARTING GROWTH IN SCIENCE SKILLS

Feedback From Assignments			Initiating and Planning		Collecting and Recording		Organizing and Communicating		Analysing		Synthesizing and Integrating		Evaluating	
Module	Section	Question	Self	Teacher	Self	Teacher	Self	Teacher	Self	Teacher	Self	Teacher	Self	Teacher
1	1	3												
	2	2												
	3	6												
2	1	1												
3	1	4												
	2	3												
	3	10												
4	1	4												
	2	1												
		4												
5	1	8												
	2	10												
6	1	5												
	2	4												
	3	2												
7	1	5												
	2	6												

Final Test

Included here is the answer key to the final test and the student's copy of the final test which is designed for photocopying and possible faxing.

Note:

The answer key and student's copy of this final test should be kept secure by the teacher. Students should not have access to this test until it is assigned in a supervised situation. The answers should be stored securely and retained by the teacher at all times.

BIOLOGY 20

FINAL TEST ANSWER KEY

Part A: Multiple Choice (30 marks)

1. B
2. D
3. C
4. C
5. A
6. C
7. A
8. B
9. C
10. C
11. C
12. C
13. A
14. A
15. C
16. A
17. D
18. B
19. C
20. D
21. A
22. A
23. B
24. C
25. C
26. D
27. D
28. B
29. A
30. B

Part B: Matching (15 marks)

1. a. desert
   b. temperate deciduous forest
   c. tundra
   d. taiga
   e. desert
   f. desert
   g. tropical rain forest
   h. grassland
   i. temperate deciduous forest
   j. taiga **(10 marks)**

MARKS	
5	all correct
	one wrong
	two wrong
4	three wrong
	four wrong
3	five wrong
	six wrong
2	seven wrong
	eight wrong
1	nine wrong
	ten wrong

2. Mouth – g, h
   Liver – b, o
   Stomach – e, j, n
   Pancreas – h
   Small intestine – a, c, d, f, i
   Large intestine – k, m

   Note: l is not used.
   (5 marks)

Part C: Written Response (55 marks)

1. Combustion of fossil fuels adds carbon and carbon dioxide to the atmosphere. Cutting and burning of the world's forests adds more carbon dioxide and reduces plants which would otherwise remove carbon dioxide by photosynthesis. Overall, the increased carbon dioxide increases the greenhouse effect. **(5 marks)**

2.

	HIGH ALTITUDE	HIGH LATITUDE
Location	Mountain tops	Near poles (north, south)
Cycles	Slow	Slow
Biotic	Low diversity	Low diversity
	Seasonal migrations	Seasonal migrations
	Many adaptations to cold	Many adaptations to cold
	Stunted vegetation	Stunted vegetation
	Lichens	Lichens
	Mosses	Mosses
	Small populations	Larger populations (e.g. caribou)
Abiotic	Low precipitation	Low precipitation
	Cold temperatures	Cold temperatures
	Short summer	Short summer
	Long winter	Long winter
	Glaciers	Permafrost

(5 marks)

3. Fish would be eating the large invertebrates that are seen in the middle of the lake. Since the invertebrates are present, the fish must be absent. **(2 marks)**

4. The presence or absence of fish could also be determined by fishing, netting, or scuba diving. **(2 marks)**

5. The lakes are poisoned to kill undesirable fish such as pike and perch. This eliminates competition for more desirable fish such as trout. **(2 marks)**

6. Brenda Miskimmin is hypothesizing that the original toxins last a long time in the lake and continue to kill fish. **(2 marks)**

7. It could have been released from the bodies of dead and decaying fish and invertebrates. It could also have settled out from the water. **(2 marks)**

8. Toxaphene may enter the food chain in simple microscopic organisms, such as primary consumers. As the toxaphene is transferred through other consumers up the food chain, its concentration increases by biological amplification. Eventually toxic levels are formed that are lethal for the next consumer, in this case fish. **(2 marks)**

9. The toxaphene concentration in the invertebrates is too low to cause death. Some invertebrates may have developed a resistance to low concentrations of toxaphene or not be ingesting it as part of their food chain. **(2 marks)**

10. Decomposers break down dead organisms from all trophic levels and release toxaphene into the lake sediments. **(2 marks)**

11. Toxaphene could enter humans when humans eat fish. **(2 marks)**

12.
- Use rotenone instead of toxaphene. Rotenone breaks down faster than toxaphene and may not enter food chains or biologically amplify.

- Return native fish species such as perch or pike to the lake.

(2 marks)

13. Population A is the wolf population. Predator numbers are usually much lower than prey numbers. The wolves increase as the moose population increases.

Population B is the moose population. The moose increase as the regenerated forest provides more food.

Population C is the caribou population. This population declines due to increased predation by wolves and increased road kills and poaching.
(5 marks)

14. a. Patient B is fighting an infection as indicated by high numbers of white blood cells. **(2 marks)**

    b. Patient A is suffering from anemia, pallor, fatigue, and lack of energy caused by too few RBCs, which reduce the oxygen-carrying capacity of the blood. **(2 marks)**

    c. Patient C is probably living at a high altitude as indicated by an abnormally high number of RBCs. **(1 mark)**

15. a. Glucose was reabsorbed into the plasma from the filtrate. It is present in plasma and filtrate but not in urine. **(1 mark)**

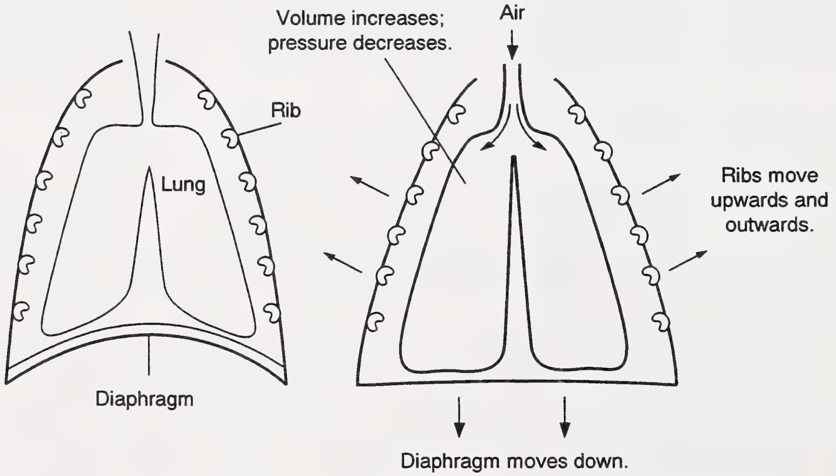
    b. Protein did not enter the nephron because protein molecules are too large to pass through the capillary in the glomerulus. **(1 mark)**

    c. The concentration of urea is high in the urine because water has been reabsorbed. **(1 mark)**

    d. Glucose would be present in the urine if the subject had diabetes mellitus. **(1 mark)**

    e. The concentration of urea would be much higher in a subject suffering from dehydration. The volume of urine, though not indicated in the results, would be lower. **(1 mark)**

16. Normally relaxed in a dome shape, the diaphragm contracts, flattens, and moves downwards. The intercostal muscles contract and pull the ribs upwards and outwards. These two actions increase the volume of the pulmonary cavity. As the volume increases, the pressure decreases. Higher external atmospheric pressure forces air into the lungs causing inhalation. **(10 marks)**


Volume increases; pressure decreases.
Air
Rib
Lung
Ribs move upwards and outwards.
Diaphragm
Diaphragm moves down.

Marker: Give five marks for explanation and five marks for labelled diagram.

BIOLOGY 20

FINAL TEST

GENERAL INSTRUCTIONS

YOU HAVE **TWO** HOURS TO COMPLETE THIS TEST. Work through the entire test answering the questions you are sure you know. You will then be able to concentrate on the questions of which you are not quite sure.

TOTAL MARKS: 100

PART A: Multiple Choice	30 marks
PART B: Matching	15 marks
PART C: Written Response	55 marks

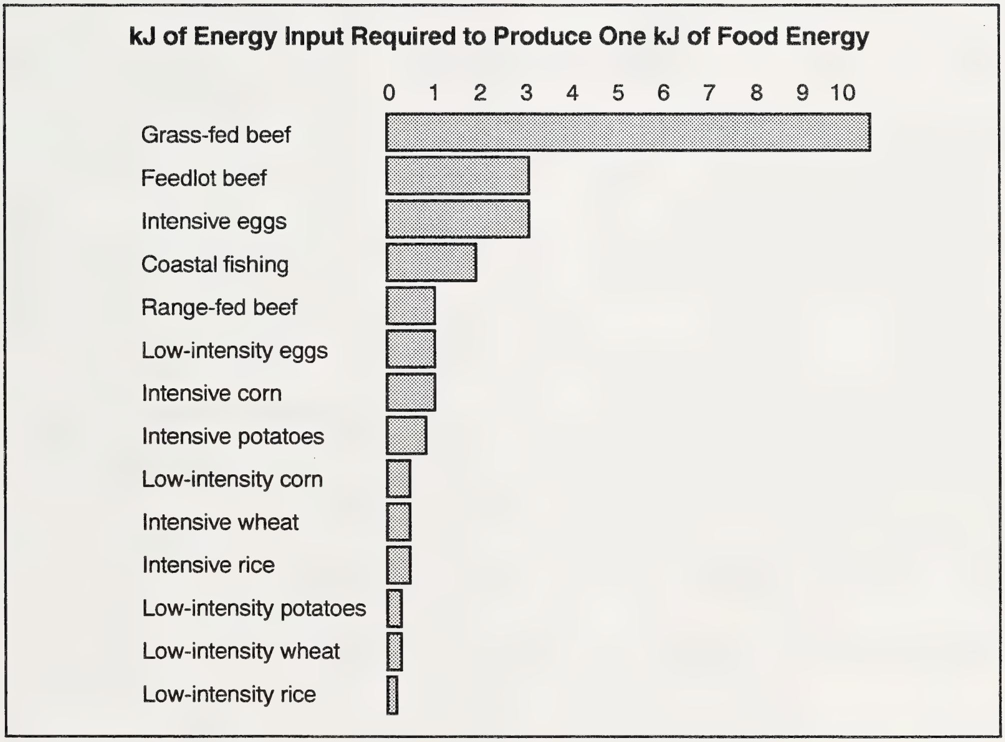
Value

PART A: MULTIPLE CHOICE

30 All multiple-choice questions must be answered on the Part A Response Page included in your test.

Read each question carefully and decide which of the choices BEST completes the statement or answers the question. Locate the question number on the Response Page and place your answer in the corresponding blank.

Use the following information to answer this question.



kJ of Energy Input Required to Produce One kJ of Food Energy

1. In terms of energy input to energy output one would say that most beef production

A. is more efficient than corn production
B. is counter-productive in energy conservation
C. gives a high energy output/input ratio
D. produces more energy than it uses

Use the following information to answer this question.

Equation I: $CO_2 + H_2O + \text{Sunlight} \rightarrow C_6H_{12}O_6 + O_2$

Equation II: $C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O + \text{Energy}$

2. The energy produced in Equation II comes from

   A. energy from sunlight transformed by cellular respiration
   B. glucose broken down by photosynthesis
   C. energy in carbon dioxide and water released by cellular respiration
   D. glucose broken down by cellular respiration

Use the following information to answer this question.

Annual Production and Respiration as Kcal/m^2/Year in Growing and Climax Ecosystems

	Alfalfa Field (USA)	Young Pine Plantations (England)	Medium-aged Oak-Pine Forest (NY)	Large Flowering Spring (Silver Springs, FL)	Mature Rain Forest (Puerto Rico)	Coastal Sound (Long Island, NY)
Gross primary production	24 000	12 200	11 500	20 800	45 000	5 700
Autotrophic respiration	9 200	4 700	12 000	12 000	32 000	3 200
Net primary production	15 200	7 500	8 800	8 800	13 000	2 500
Heterotrophic respiration	800	4 600	6 800	6 800	13 000	2 500
Net community production	14 000	2 900	2 000	2 000	very little or none	very little or none

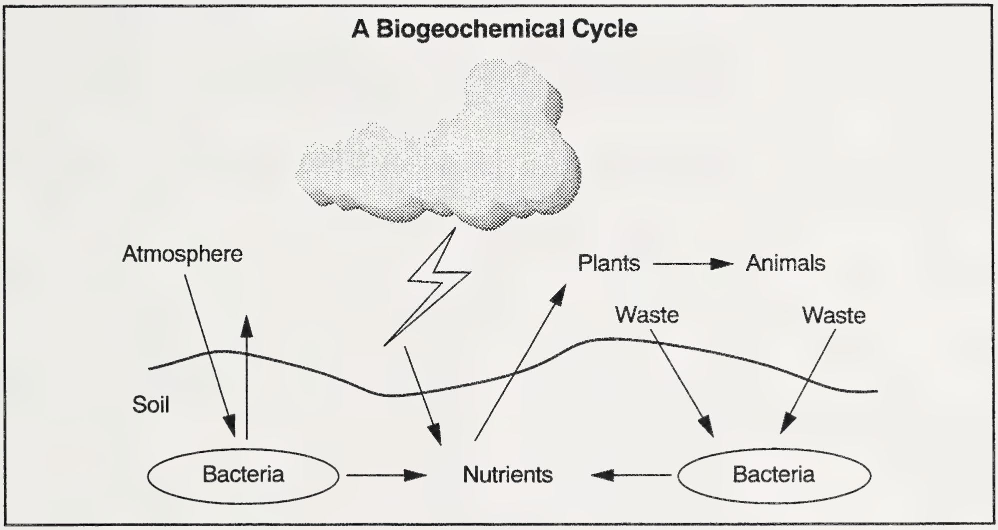
3. Which of the following statements about the data from the table is correct?

   A. Animal respiration is greater than plant respiration in each ecosystem.
   B. Net primary production equals photosynthesis minus respiration in all cases.
   C. Plant respiration is greater than animal respiration in each ecosystem.
   D. Net production increases from pole to equator.

4. An atom of carbon that remains in an organic compound for 100 million years before it re-enters the atmosphere might be found within a

   A. carbonate ocean solution undergoing precipitation
   B. fossil fish displayed in a museum
   C. fossil fuel undergoing combustion
   D. carbonate rock undergoing erosion

Use the following information to answer this question.



5. Which biogeochemical cycle is illustrated in the graphic?

   A. nitrogen cycle
   B. water cycle
   C. carbon cycle
   D. phosphorous cycle

6. An ecosystem is a

   A. group of components that interact with one another
   B. group of interacting species in one place at one time
   C. biologic community and components of the physical environment with which the community interacts
   D. group of interacting chemicals and their cycles

7. Energy and nutrients enter a community by way of the

   A. producers
   B. consumers
   C. scavengers
   D. detritivores

8. A sequence of species through which the organic molecules in a community pass is called a

   A. pyramid of energy
   B. food chain
   C. food web
   D. nutrient cycle

9. A consumer whose carbon atoms have already passed through three species is a

   A. scavenger
   B. tertiary producer
   C. tertiary consumer
   D. secondary consumer

10. A group of interconnected food chains is called a

    A. pyramid of energy
    B. complex food chain
    C. food web
    D. food cycle

11. The human embryo and all other vertebrate embryos have gill slits. This best supports the following idea:

    A. Fish are humans' closest relatives.
    B. The embryo breathes under water.
    C. All vertebrates are related.
    D. Fish are in the same genus as man.

12. Poorly developed or nonfunctioning organs are known as

    A. homologous
    B. analogous
    C. vestigial
    D. haploid

13. Darwin was influenced by Malthus' conclusion that

    A. organisms tend to multiply up to the limit of their food supply
    B. food supplies can be increased faster than the organisms which depend on the food supply
    C. changes in population size are so regular that they can be predicted
    D. populations fluctuate in regular cycles

14. A population is a group of organisms that

    A. occupy the same range
    B. interbreed in natural surroundings
    C. are able to interbreed because of genetic similarities
    D. does not have a tendency to migrate

15. All of the following are parts of Darwin's idea of how evolution occurs except

    A. there is an overproduction of offspring
    B. members of a population struggle for existence
    C. the use or disuse of organs contribute to heritable variation
    D. heritable variation exists within a population

16. If there were no variations among organisms of a species, new species would

    A. not be produced
    B. become larger in body size
    C. become better adapted to new environments
    D. be produced by natural selection

17. An inherited adaptation of a species is significant to evolution because certain members of the species will

    A. remain unchanged
    B. find an environment where such an adaptation is not harmful
    C. have less chance of surviving
    D. have a better chance of surviving

18. Whether a specific variation improves the chances for the survival of an organism or not depends on

    A. the reproductive rate of the organism
    B. the environment of the organism
    C. the use and disuse of the variation
    D. the age of the organism

19. Over the ages, desert camels have developed broad, padded feet. Charles Darwin would account for this by stating the following:

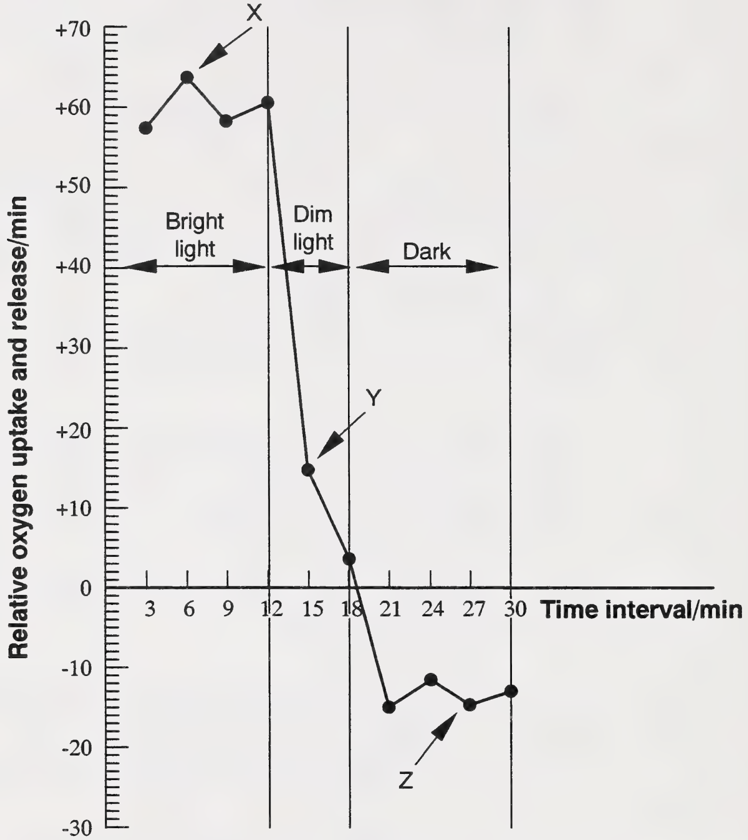
    A. Camels needed these specialized feet to survive on the desert.
    B. Camels broadened their feet by walking on them in the desert.
    C. Camels with naturally broader feet would be more likely to survive and reproduce.
    D. Camels that broadened their feet by walking had offspring with broad feet.

20. All members of the species *Homo sapiens* are grouped together because they

    A. are similar in appearance
    B. show only slight differences in skull shape
    C. show only slight differences in texture and distribution of body hair
    D. can interbreed and produce fertile offspring

Use the following information to answer the next two questions.

Effect of Light on Oxygen Uptake and Release in Green Plants



21. An experiment was performed to determine the effects of light on oxygen uptake and release in green plants. Point Z on the graph indicates which of the following conditions?

A. highest glucose consumption
B. lowest rate of cellular respiration
C. highest oxygen production
D. lowest carbon dioxide production

22. Point X on the graph indicates which of the following conditions?

A. ATP production by chemiosmosis
B. ATP consumption by cell metabolism
C. ATP consumption by photosynthesis
D. ATP production by cellular respiration

23. What happens when light is absorbed by a chloroplast?

    A. There is a transfer of electrons that results in a production of CO_2 and H_2O.
    B. Electrons of chlorophyll are energized and the energy is transferred to assemble ATP and NADPH.
    C. ATP is reduced to ADP, releasing energy that will be used in the grana to assemble glucose.
    D. Photolysis can be carried out so that the Calvin-Benson cycle is not necessary.

24. The cell produces energy molecules in the form of ATP from cellular respiration. However, the raw materials are not converted directly by chemical alteration to form ATP. An explanation of this process would be that

    A. kinetic light energy is converted to potential chemical energy and ATP is formed
    B. raw material molecules are completely broken down and the atoms are rearranged as ATP
    C. chemical bond energy released from the raw materials is used to assemble ATP
    D. raw material molecules require only slight alteration in order to form ATP

25. Glycolysis occurs in the absence of

    A. water
    B. glucose
    C. oxygen
    D. carbon dioxide

26. The source of energy for virtually all life on Earth is the sun. The form of matter that provides the energy for most living organisms would probably be

    A. DNA, which controls all life processes
    B. water as organisms are composed mostly of water
    C. carbon dioxide and water from which the basic life chemicals are made
    D. carbohydrates, which contain stored energy

27. ATP is the energy molecule of cells because

    A. it is very large
    B. it carries an electrical charge
    C. it contains high energy hydrogen bonds
    D. it contains high energy phosphate bonds

28. Most of the ATP produced in aerobic respiration is formed by

    A. the Krebs cycle
    B. the electron transport chain
    C. glycolysis
    D. oxidation of carbon dioxide

29. The final acceptor of hydrogen ions in aerobic respiration is

    A. oxygen
    B. pyruvic acid
    C. carbon dioxide
    D. glucose

Use the following information to answer question 30.

Oxygen Consumption by Several Animals	
Animal	**Oxygen Consumption (cm^3/kg/h)**
Earthworm	75
Butterfly	500
Frog	120
Hummingbird	11 000
Mouse	3 000
Human	200

30. Which of the following statement would be true?

A. ATP production (/kg/h) is greater in a frog than in a mouse.
B. Glucose utilization (/kg/h) is greater in a mouse than in a man.
C. Butterflies and hummingbirds produce the same amount of energy (/kg/h).
D. More carbon dioxide (cm^3/kg/h) is produced by a man than by a hummingbird.

PART A: RESPONSE PAGE

_______ 1.

_______ 2.

_______ 3.

_______ 4.

_______ 5.

_______ 6.

_______ 7.

_______ 8.

_______ 9.

_______ 10.

_______ 11.

_______ 12.

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_______ 15.

_______ 16.

_______ 17.

_______ 18.

_______ 19.

_______ 20.

_______ 21.

_______ 22.

_______ 23.

_______ 24.

_______ 25.

_______ 26.

_______ 27.

_______ 28.

_______ 29.

_______ 30.

Name of Student _______________________ Student I.D. # _______________

Name of School _______________________ Date _______________

Value

PART B: MATCHING

15 Answer each of the following questions using the space provided.

(10 marks) 1. Match the description with the appropriate biome.

Biomes:
- desert
- grassland
- taiga
- temperate deciduous forest
- tropical rain forest
- tundra

Description:

a. ________ Ten or fewer centimetres of rainfall occur annually.

b. ________ Broadleaf trees such as oak, maple, and beech occur.

c. ________ Stunted plants and permafrost occur.

d. ________ Extensive stands of pine, spruce, or other conifers occur.

e. ________ Extreme day-night temperature ranges and flashflooding occur.

f. ________ Fleshy, water-storing plants are common.

g. ________ There is little annual variation in temperature, but torrential rains are common.

h. ________ The largest known populations of big herbivores are found here.

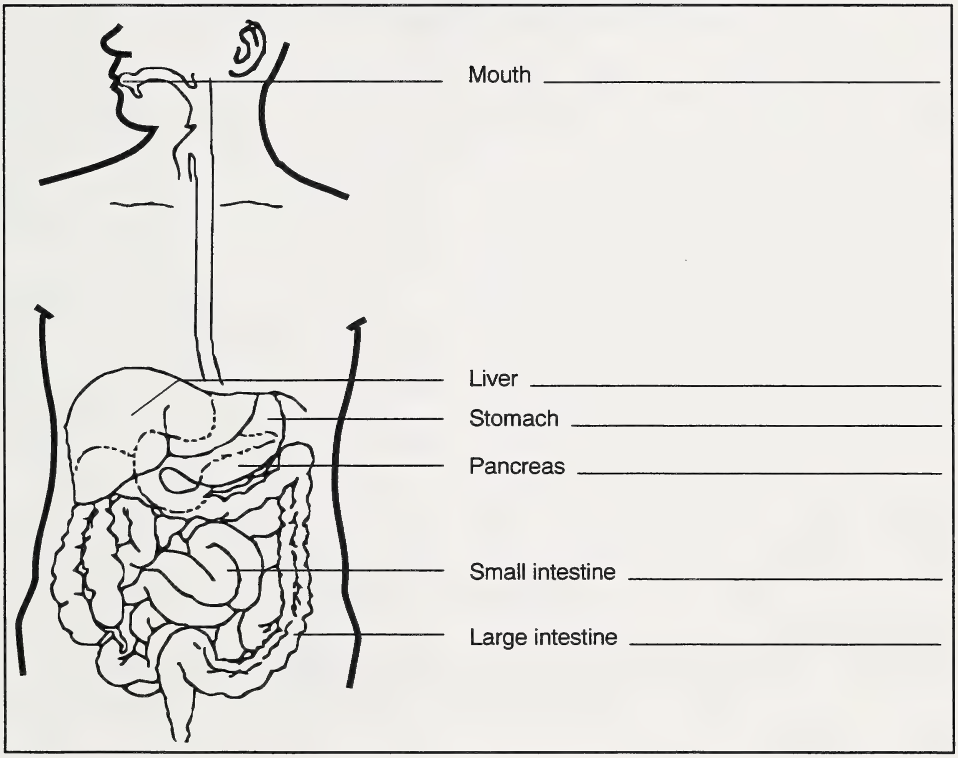
i. ________ Plants commonly shed leaves seasonally becoming dormant in winter.

j. ________ Needle-leaved trees abound; long, cold winters are common.

Name of Student ________________	Student I.D. # ________________
Name of School ________________	Date ________________

(5 marks)

2. On the following diagram, match the functions with the appropriate parts of the digestive system. Place the correct letter from one or more of the functions in the space beside the identified part. Some functions may apply to more than one part. Some body parts may have several functions. Not all functions must be used.



Functions

a. Lipases hydrolyse fats into glycerol and fatty acids.
b. Bile is produced.
c. The pyloric sphincter opens and nutrients enter this region.
d. Most of the food molecules are absorbed.
e. Pepsinogen is converted to pepsin.
f. Proteins are broken down into amino acids.
g. The presence of food stimulates the secretion of amylases.
h. Alkaline fluid is secreted.
i. The stomach acids are neutralized.
j. HCl loosens the fibrous components of food.
k. Indigestible food remains are broken down by bacteria.
l. Bile is stored.
m. Water is reabsorbed.
n. Gastrin is released into the bloodstream.
o. Glucose is converted to glycogen and stored.

Name of Student ______________________ Student I.D. # ______________

Name of School ______________________ Date ______________

Value

PART C: WRITTEN RESPONSE

55 Answer each of the following questions using the space provided.

(5 marks) 1. Carefully describe how human activities interfere with the carbon cycle. Include some results of this interference in your answer.

(5 marks) 2. Use a table to compare and contrast high altitude and high latitude biomes. Mention geographic location, biogeochemical cycles, and biotic and abiotic factors in your answer.

Name of Student ____________________ Student I.D. # ____________________

Name of School ____________________ Date ____________________

Carefully read the article *Lake's legacy: poisoned fish, failed program*, and answer questions 3 to 12 that follow.

Lake's legacy: poisoned fish, failed program

Trout-stocking efforts a flop

ED STRUZIK
Journal Staff Writer

Edmonton

Fish and Wildlife officials have used nearly a million trout over the past 30 years trying to stock a small lake near Bonnyville.

They still haven't succeeded in their goal of establishing a viable sport fishery.

"I'm sure there's no fish in there because you can see these giant invertebrates swimming around quite happily in the middle of the lake," says zoologist Brenda Miskimmin of the University of Alberta.

"If there were fish, they'd be eating them," she said, referring to invertebrates such as fresh-water shrimp and scuds.

Miskimmin believes that the lake is still suffering the consequences of a poisoning program in the 1950s and 1960s that was designed to kill so-called "undesirable" fish in favour of trout, which are preferred by sport fishermen.

"In order to do this, they had to get rid of all of the perch and pike first because they out-compete trout for food," she explained. "But what they didn't fully appreciate was that the poison they used killed a lot more than just fish. It killed most of the other living organisms in the lakes as well."

The poison in this case was toxaphene, a carcinogenic chemical that was banned in both Canada and the United States in the early 1980s. Miskimmin suspects it may still be causing problems because she has found traces of it in the sediment that lies on the lake bottom.

"It is possible that like DDT and PCB in the Great Lakes, it is still being recycled in the ecosystem. The small invertebrates are taking it up and passing it on to the larger organisms that feed on them. This is a chemical that does not break down easily."

Miskimmin is conducting research with an $18 000 fellowship she received recently from the Tri-Council Secretariat created by the Medical Research Council, the Natural Sciences and Engineering Research Council, and the Social Sciences and Humanities Research Council. The fellowship is given annually to select doctoral students working on environmental problems.

"My interest is in reconstructing the aquatic history of four lakes in the province that have been subjected to poisoning," she said. "We know what happened to the fish, for example. But we're still not sure what happened to the other members of the ecosystem. If we can find out these answers, it will help us set up a framework for restoring life in lakes that have been affected in this way."

Miskimmin isn't sure how many lakes have been poisoned for this purpose. But the practice was evidently fairly widespread, having occurred in some of the Rocky Mountain national park lakes as well. The lakes were also quite small, primarily because the poison was expensive. The bigger the lake, the more poison that was required to kill the fish.

Toxaphene wasn't the only poison used, she noted. Fish and Wildlife officials used, and are still using, rotenone to kill native fish species to make room for rainbow trout.

Rotenone is a less toxic plant byproduct that breaks down relatively quickly, said Miskimmin. But it also kills more than just fish.

Fisheries managers should look at the past to understand the impact of what they are doing today, she said.

"There was a lot of pressure from the sport fishing community to have the government stock lakes with rainbow trout.

"Hopefully, that pressure is easing a bit a more and more fishermen realize that there is nothing wrong with catching a jumbo perch."

"If we're going to restore the health of these lakes that have been poisoned, I think that it would be wise to return the lakes to the native species. They're the fish that are going to do best in the long run."[1]

---

[1] *The Edmonton Journal*, Friday, October 23, 1992, page A7.

(2 marks) 3. What is the basis for the conclusion that there are no fish surviving in the lake?

(2 marks) 4. How else could the presence or absence of fish be determined?

(2 marks) 5. Why are lakes poisoned in the first place?

(2 marks) 6. Describe the scientist's hypothesis.

(2 marks) 7. Explain how the toxaphene got into the lake sediments.

Name of Student ______ Student I.D. # ______
Name of School ______ Date ______

(2 marks) 8. If trace amounts of toxaphene are still present in lake sediments, how could this toxin reach levels sufficient to continue to kill fish?

(2 marks) 9. Why doesn't toxaphene kill all the invertebrates in the lake?

(2 marks) 10. Explain how decomposers play a role in this problem.

(2 marks) 11. Humans usually do not eat aquatic invertebrates. How could toxaphene be passed to humans?

(2 marks) 12. Describe two solutions proposed by the scientist.

Name of Student ______ Student I.D. # ______

Name of School ______ Date ______

Use the following information to answer the next question.

Alberta populations of woodland caribou have been decreasing in the past several years. One major influence has been the logging of mature forests which contain lichens necessary for caribou to survive the winter.

The young regenerated forest provides good food supply for moose, deer, and elk, which in turn will attract and support the growth of a wolf population which preys on the caribou.

Oil and gas activity in these logged areas further increase human contact with the caribou and increase poaching and accidental deaths. The wolves use cutlines and skidoo trails to increase their hunting range.

The following table shows the changes in the populations of animals in the time following the logging of a mature forest.

CHANGES IN THREE POPULATIONS OF ANIMALS

Time (Years)	Population A	Population B	Population C
1	10	20	300
2	15	22	290
3	20	24	280
4	25	25	270
5	35	30	250
6	40	35	210
7	45	65	200
8	50	75	200
9	52	80	170
10	56	100	160
11	58	150	150
12	59	180	140
13	60	250	130
14	60	280	120
15	60	300	110
16	60	300	100
17	61	310	100
18	60	320	100
19	59	310	90

(5 marks) 13. Identify population A, B, and C and explain your choice.

____

____

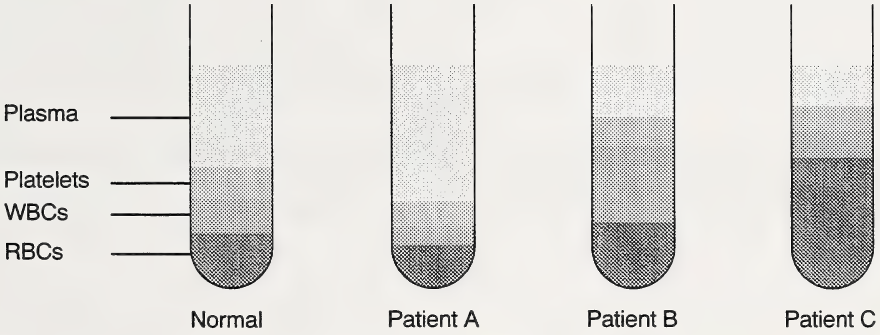
____

Name of Student ______________________ Student I.D. # ______________________

Name of School ______________________ Date ______________________

(5 marks)

14. The following blood samples were taken from three patients and centrifuged (spinning at high speed) to separate the blood cell layers. Examine the samples carefully and respond to the questions that follow:



a. Which patient is probably fighting an infection? Explain.

Name of Student ______________________	Student I.D. # ______________
Name of School ______________________	Date ______________

b. Describe the symptoms which Patient A will be most likely be experiencing. Defend your answer.

c. Which patient is living at a high altitude? Explain.

(5 marks) 15. Use the information in the following chart to answer the following questions about excretion.

Substance	**In Plasma mmol/L**	**In Capsular Filtrate mmol/L**	**Urine mmol/L**
Glucose	11.1	11.1	0.0
Protein	20.0	0.0	0.0
Urea	25.0	25.0	120.8

a. Which of the substance(s) was reabsorbed? Explain.

b. Which substance did not enter the nephron? Explain.

Name of Student ____________________ Student I.D. # ____________________

Name of School ____________________ Date ____________________

c. The concentration of urea is extremely high in the urine. Explain why this occurred?

d. How would these test results be different for a subject with diabetes mellitus?

e. How would these test results be different for a subject suffering from dehydration?

(10 marks) 16. Explain how the coordination of the diaphragm and intercostal muscles (muscles between ribs) acts to change the volume and pressure of the pulmonary cavity and cause inhalation. Include a diagram in your answer and label the diagram to show the various structures and how they move.

Name of Student	Student I.D. #
Name of School	Date

TEACHER QUESTIONNAIRE FOR BIOLOGY 20

This is a course designed in a new distance-learning format, so we are interested in your responses. Your constructive comments will be greatly appreciated so that a future revision may incorporate any necessary improvements.

Teacher's Name ______________________ Area of Expertise ______________________

School Name ______________________ Date ______________________

Design

1. The modules follow a definite systematic design. Did you find it easy to follow?

   ☐ Yes ☐ No If no, explain.

   ____

   ____

2. Did your observations reveal that the students found the design easy to follow?

   ☐ Yes ☐ No If no, explain.

   ____

   ____

3. Did you find the Learning Facilitator's Manual helpful?

   ☐ Yes ☐ No If no, explain.

   ____

   ____

4. Part of the design involves stating the objectives in student terms. Do you feel this helped the students understand what they were going to learn?

   ☐ Yes ☐ No If no, explain.

   ____

   ____

5. The Learning Facilitator's Manual contains Assignment answers and a sample test. Did you find these helpful?

☐ Yes ☐ No If no, explain.

____

____

6. Did the Follow-up Activities prove to be helpful?

☐ Yes ☐ No If no, explain.

____

____

7. Were students motivated to try these Follow-up Activities?

☐ Yes ☐ No If no, give details.

____

____

8. Suggestions for computer and video activities are included in the course. Were your students able to use these activities?

☐ Yes ☐ No Comment on the lines below.

____

____

9. Were the assignments appropriate?

☐ Yes ☐ No If no, give details.

____

____

10. Did you fax assignments? ☐ Yes ☐ No

11. If you did fax, did you get satisfactory results from using this procedure?

☐ Yes ☐ No If no, give details.

____

____

Instruction

1. Did you find the instruction clear?

☐ Yes ☐ No If no, give details.

2. Did your observations reveal that the students found the instruction interesting?

☐ Yes ☐ No If no, give details.

3. Did you find the instruction adequate?

☐ Yes ☐ No If no, give details.

4. Was the reading level appropriate?

☐ Yes ☐ No If no, give details.

5. Was the work load adequate?

☐ Yes ☐ No If no, give details.

6. Was the content accurate and current?

☐ Yes ☐ No If no, give details.

7. Did the content flow consistently and logically?

☐ Yes ☐ No If no, give details.

8. Was the transition between booklets smooth?

☐ Yes ☐ No If no, give details.

9. Was the transition between print and media smooth?

☐ Yes ☐ No If no, give details.

Additional Comments

Thanks for taking the time to complete this survey. Your feedback is important to us.

Fax Number: 674-6686

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Note: Please ensure that each of your students has completed and forwarded a copy of the Course Survey.

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Biology 20

Learning Facilitator's
Manual

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